San Francisco–Oakland Bay Bridge
East Span Seismic Safety Project

Pier E3 Demonstration Project
Biological Monitoring Programs

EA 04-013544

EFIS#: 0415000281

04-SF-80 KP 12.2/KP 14.3

04-ALA-80 KP 0.0/KP 2.1

October 2015

California Department of Transportation

Caltrans

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The environmental review, consultation, and any other action required in accordance with applicable Federal laws for this project is being, or has been, carried-out by the Department under its assumption of responsibility pursuant to 23 USC 327.

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List of Abbreviated Terms

°C	degrees Celsius
µPa	micro Pascal
ADCP	Acoustic Doppler Current Profiler
ADD	acoustic deterrent device
AMP	Avian Monitoring Plan
BAS	Blast Attenuation System
Bay	San Francisco Bay
BCDC	San Francisco Bay Conservation and Development Commission
BMMP	Bird Monitoring and Management Plan
BMP	Bird Management Plan for Bridge Dismantling
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CFGC	California Fish and Game Code
CTD	conductivity-temperature-depth
dB	decibel(s)
Demonstration Project	demonstration project to remove Pier E3 via highly controlled charges
Department	California Department of Transportation
DO	dissolved oxygen
ESA	environmentally sensitive area
FESA	Federal Endangered Species Act
IHA	Incidental Harassment Authorization
ITP	Incidental Take Permit
kHz	kilohertz
km	kilometer(s)
L_{peak}	peak level
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
MHz	Megahertz
MW	Megawatt

mi	mile(s)
MMC	Marine Mammal Center
MMO	marine mammal observers
MMPA	Marine Mammal Protection Act
MTSZ	Marine Traffic Safety Zone
NGVD29	National Geodetic Vertical Datum of 1929
NIST	National Institute of Standards and Technology
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity units
OTD	Oakland Touchdown
POTW	publically owned treatment works
psi	pound per square inch
QA/QC	quality assurance/quality control
RMS	root mean square
RWQCB	Regional Water Quality Control Board
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SFOBB	San Francisco–Oakland Bay Bridge
SFOBB Project	San Francisco–Oakland Bay Bridge East Span Seismic Safety Project
SMP	Self-Monitoring Program
SPL	sound pressure level
SWPPP	Storm Water Pollution Prevention Plan
T	turbidity
TTS	Temporary Threshold Shift
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WDR	Waste Discharge Requirement
YBI	Yerba Buena Island

Chapter 1. Introduction

The California Department of Transportation (Department), as part of the San Francisco–Oakland Bay Bridge (SFOBB) East Span Seismic Safety Project (SFOBB Project), is in the process of dismantling the original east span of the SFOBB. As part of the dismantling phase of the SFOBB Project, the Department is proposing a demonstration project to remove Pier E3 via highly controlled charges (Demonstration Project). Controlled implosion is proposed as an alternate method to the originally permitted mechanical methods for dismantling Pier E3, because it is expected to result in fewer in-water work days, have a reduced impact on environmental resources of the San Francisco Bay (Bay), and require a shorter time frame for completion. To minimize impacts on biological resources and determine the level of hydroacoustic noise from the Demonstration Project, the Department will be implementing several monitoring efforts. The purpose of this document is to provide a compendium of the biological monitoring programs proposed for the Demonstration Project.

Chapter 2. Background

2.1. Original East Span Bridge & Pier E3

Construction of the original east span of the SFOBB, connecting Yerba Buena Island (YBI) and the Oakland shoreline, was completed in 1936. The original east span was a double-deck structure, 12,127 feet (3,696 meters) in length and approximately 58 feet (18 meters) wide, carrying five traffic lanes in both eastbound and westbound directions. The original east span was supported by 21 -water bridge piers (existing Piers E2 through E22), as well as land-based bridge piers and bents on both YBI and the Oakland shoreline.

Pier E3 is located on the original east span, west of the Oakland Touchdown (OTD) area, approximately 1,535 feet (468 meters) east of YBI near the coordinates $37^0$48'56.75"N $122^0$21'14.75"W, and within San Francisco County. Pier E3 rests in a depth of water that is approximately 50 feet (15 meters), and it flanks the east side of a deeper shipping channel between YBI and Oakland. Top dimensions of the pier cap are 80 feet (24 meters) by 134.5 feet (41 meters), not including the fender apron. Exterior walls along the perimeter of the caisson are 4 feet (1.2 meters) wide, while the interior walls of the rectangular chambers are 3.3 feet (1 meter) in width. The mudline (i.e., the bottom of the Bay floor) at Pier E3 ranges in elevation from -43 to -51 feet (National Geodetic Vertical Datum of 1929 [NGVD29]). The pier cap, fender system, and uppermost portions extend above the water line to support the steel superstructure of the cantilever section and are visible from the Bay.

2.2. Summary of Project Activities

Dismantling of Pier E3 will take place in the following four phases:

- Mechanical dismantling of pier cap and fender system;
- Drilling of bore holes into caisson and buttress walls, and installing the Blast Attenuation System (BAS);
- Installing charges, activating the BAS, and imploding the pier; and
- Management and removal of remaining dismantling debris.

Mechanical dismantling of Pier E3 began in June 2015, following removal of the SFOBB cantilever truss section and steel support tower on the original east span. The basic steps include removing the timber and steel-supported fender system that surrounds Pier E3, dismantling of the concrete pier cap by mechanical means to an elevation of +9 feet, and drilling vertical boreholes to load charges for the controlled implosion.

To help minimize impacts on biological resources, the controlled implosion event will be conducted at a slack tide in November 2015. Charges are to be loaded into the drilled boreholes, as defined in the Blast Plan for the Demonstration Project (Department 2015b). Controlled implosion will be accomplished using hundreds of small charges with delays between individual charges. The entire detonation sequence of controlled implosion charges will last approximately 4 to 6 seconds and will remove the pier to, or below, the current surrounding scour elevation of -51 feet. To minimize impacts on marine biological resources in the Bay, a BAS will be installed around the base of the pier. The BAS is specifically designed to minimize noise and pressure impacts that will be generated by the controlled implosion. Installation of the BAS will be concurrent with the borehole drilling process.

Individual cartridge charges, instead of pumpable liquid blasting agents, have been chosen to provide greater control and accuracy in estimating the individual and total charge weights. Charges will be transported by boat to Pier E3. Security will be required for transporting, handling, and processing of the charges.

The boreholes will vary in diameter and depth, and will be optimized for charge efficiency. Individual and total charge weight loads are provided in the Blast Plan. The charges will be arranged in different levels (decks), separated in the boreholes by stemming. Stemming is the insertion of inert materials, like sand or gravel, to insulate and retain the charges in an enclosed space. Stemming allows for a more efficient transfer of energy into the structural concrete for fracture, and further reduces the release of potential energy into the adjacent water column. The total number of charges and delays, and total shot time are provided in the Blast Plan.

Public safety measures will be implemented during the controlled implosion event. Safety zones will be established and enforced by the Department, in conjunction with the California Highway Patrol, and with support from the United States Coast Guard (USCG) to exclude commercial and recreational marine vessels. Safety procedures will include a rolling traffic stop in both directions on the new east span of the SFOBB, in advance of detonation. After the BAS is determined to be functional, the controlled implosion

sequence will be started. The Department will implement a traffic management plan during the controlled implosion event.

Following completion of the dismantling activities, any concrete debris remaining above the scour line will be removed by the following process:

- Debris will be removed to the current scour line elevation of -51 feet and will be placed in the remaining open caisson void, or will be raised to the surface to be processed.
- Rebar will be removed to minimize bridging of open caisson cells.
- Any processed debris will be placed into the open voids of the caisson for disposal.

The entire removal of Pier E3 is expected to last approximately 7 months.

Chapter 3. Marine Mammal Monitoring Plan

SFOBB Project activities associated with dismantling of the original east span have the potential to result in the incidental take of marine mammals. The Department was issued an Incidental Harassment Authorization (IHA), pursuant to the Marine Mammal Protection Act (MMPA), by National Marine Fisheries Service (NMFS) on July 17, 2015, for the take of California sea lions (*Zalophus californianus*), Pacific harbor seals (*Phoca vitulina richardii*), harbor porpoises (*Phocoena phocoena*), and gray whales (*Eschrichtius robustus*) by behavioral harassment incidental to vibratory pile driving, attenuated impact pile driving, pile proofing, and mechanical dismantling. Monitoring of these activities are covered under a revised Marine Mammal Monitoring Plan that was submitted to NMFS in 2013 (Department 2013d). Marine mammal monitoring for the mechanical dismantling of the Pier E3 pier cap and drilling of the pier and buttress walls will follow the protocol outlined in the revised 2013 monitoring plan.

For the Demonstration Project, the Department was issued an IHA by NMFS on September 9, 2015 (valid October 1 through December 30, 2015), to incidentally take (by harassment during implosion of Pier E3) small numbers of California sea lions, northern elephant seals (*Mirounga angustirostris*), Pacific harbor seals, and harbor porpoises. The Marine Mammal Monitoring Plan presented herein has been prepared in compliance with the requirements of that IHA. This Marine Mammal Monitoring Plan discusses the use of controlled charges for demolition of Pier E3, injury and harassment threshold criteria zones, and specific methods for monitoring and reporting marine mammal activity near the implosion area.

3.1. Regulations Pertaining to Marine Mammals

Under the MMPA “take” is defined as “harass, hurt, capture, kill or collect, or attempt to harass, hurt, capture, kill or collect.” Under the 1994 Amendment to the MMPA, harassment is defined statutorily as “any act of pursuit, torment, or annoyance which has the potential to injure or disturb a marine mammal or marine mammal stock in the wild.” Harassment which has the potential to injure or killa marine mammal is further defined as Level A harassment. Harassment that has the potential to disturb a marine mammal by causing disturbance of behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal, is further defined as Level B harassment.

In 2001, in accordance with the MMPA, the Department requested authorization from NMFS for possible harassment of small numbers of two pinniped species, California sea lions, Pacific harbor seals, and one cetacean species—gray whales, incidental to conducting the SFOBB Project. NMFS requires that before issuance of an IHA or the start of any permitted activities, a marine mammal monitoring plan that incorporates mitigation, monitoring, and reporting requirements described in the IHA request be prepared. NMFS specifies the following requirements for the marine mammal monitoring plan (Federal Register 2001):

> The complete monitoring plan must include: (1) a description of the proposed survey techniques that will be used to determine the movement and activity of marine mammals near the construction areas; and (2) scientific rigor that will allow NMFS to verify that any impacts on marine mammal populations from this specific activity are small in number and negligible.

On November 10, 2003, NMFS issued an IHA to the Department, authorizing the take of a small number of marine mammals incidental to the SFOBB Project. An IHA is valid only for one year. The Department has been issued nine subsequent IHAs for the SFOBB Project, in 2005, 2007, 2009, 2011, January 2013, December 2013, 2014, July 2015 (covering vibratory pile driving, attenuated impact pile driving, pile proofing, and mechanical dismantling), and September 2015 (covering implosion of Pier E3). Harbor porpoise was added to the Department's IHA authorization in 2007. The first five IHAs (2003, 2005, 2007, 2009, and 2011) addressed potential impacts on marine mammals and monitoring requirements associated with pile driving for the construction of the new east span. The 2013, 2014, and July 2015 IHAs addressed activities associated with both construction of the new east span and dismantling of the original east span.

The IHA issued on September 9, 2015 (valid October 1 through December 30, 2015) addresses the Pier E3 Implosion Demonstration Project. The Marine Mammal Monitoring Plan presented here has been prepared in compliance with the requirements of that IHA.

3.2. Marine Mammal Species of Concern

Six species of marine mammals regularly inhabit or seasonally enter the Bay. The two most common species observed are the Pacific harbor seal and the California sea lion. Northern elephant seal seasonally enters the Bay during spring and fall, and harbor porpoise may enter the Bay throughout the year, but both species tend to occur along the western margin of the Bay and rarely are observed near the east span of the SFOBB.

Gray whale may enter the Bay during the northward migration in the spring, and bottlenose dolphin (*Tursiops truncatus*) may enter the western side of the Bay; neither is likely to occur near the east span of the SFOBB in November. Neither gray whale nor bottlenose dolphin is expected to be within the Pier E3 area in November, when demolition is scheduled to occur. None of these species is listed as endangered or threatened under the Federal Endangered Species Act (FESA), or as depleted or a strategic stock under the MMPA. In addition to the six common or seasonal species, eight species of marine mammals are considered extralimital (rare sightings or strandings) and are unlikely to occur in the Bay.

3.2.1. California Sea Lions (United States Stock)

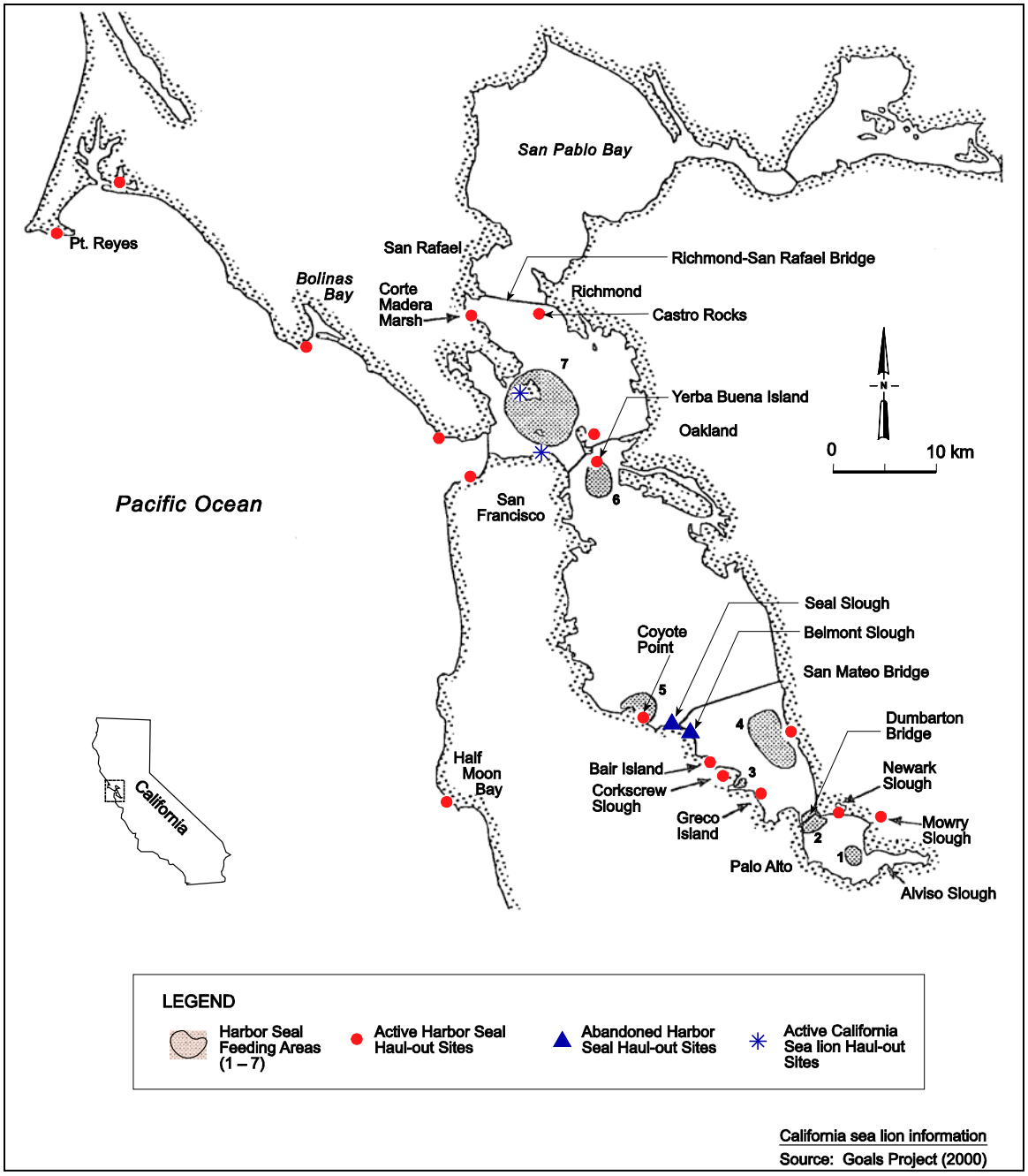
Status: The California sea lion is protected under the MMPA, but it is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2012), or listed as endangered or threatened under the FESA. The United States stock has been increasing since 1975 through 2008, with an estimated population of 296,750 sea lions (Carretta et al. 2012).

Use of SF Bay and SFOBB Area: During past monitoring for the SFOBB Project, 69 California sea lions were observed between 2000 and 2014. Sea lions appeared to be transiting through the SFOBB area rather than feeding, with the exception of a single observation. In 2004, several sea lions were observed following a school of Pacific herring that moved through the SFOBB construction area.

Since at least 1987, sea lions have been observed occupying the docks near Pier 39 in San Francisco, about 5.7 kilometers (km) [3.5 miles (mi)] from the project site (Figure 1). According to the Marine Mammal Center (MMC) in Sausalito, the number of sea lions hauled out at Pier 39 ranged from 63 to 737 in 1998, and from 5 to 906 in 1997. For both years, the lows occurred in June and the highs occurred in August. On September 1, 2001, approximately 1,105 sea lions were observed on K dock at Pier 39.

No pupping has been observed at this site or any other site in the Bay (Lander, pers. comm., 1999). The sea lions appear at Pier 39 after returning from the Channel Islands at the beginning of August (Bauer 1999). Around late winter, sea lions start to disperse down the Coast, and their numbers at Pier 39 decline. The lowest numbers of sea lions usually are observed from May through July.

Pier 39 has become a regular haul-out site for sea lions; approximately 85 percent of the animals hauled out are males. The numbers of sea lions at the haul-out site fluctuate throughout the year and even from one week to the next. For example, in June 1998, a



Source: Garcia and Associates

Figure 1. Harbor Seal and California Sea Lion Haul-out Sites and Feeding Areas in the San Francisco Bay Area

maximum of 574 sea lions was observed on June 7, while a low count of 63 was observed on June 25 (Lander, pers. comm., 1999).

Although little information is available on the foraging patterns of California sea lions in the Bay, individual sea lions have been observed feeding in the shipping channel to the south of YBI on a fairly regular basis (Grigg, pers. comm., 1999, 2001). Foraging by sea lions that use the Pier 39 haul-out site primarily occurs in the Bay, where they feed on Pacific herring (*Clupea harengus*), northern anchovy (*Engraulis mordax*), sardines (*Sardinops sagax caerulea*), and other prey (Hanni and Long 1995).

3.2.2. Pacific Harbor Seals (California Stock)

Status: The harbor seal is protected under the MMPA, but it is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013), or listed as endangered or threatened under the FESA. The California stock of harbor seals has been increasing since 1972, but at a slower rate since 1990, with a maximum count of 26,333 (uncorrected for seals at sea) in 2004 (Lowry and Carretta 2003; Lowry et al. 2008; Carretta et al. 2012). The population size for the California stock is estimated at 30,196 seals (corrected to include seals at sea; Lowry et al. 2008; Carretta et al. 2012).

Use of the San Francisco Bay and SFOBB Area: Harbor seal is the most common marine mammal species observed in the Bay and it also commonly is seen near the east span of the SFOBB (Department 2013a, 2013b). Tagging studies have shown that most seals tagged in the Bay remain in the Bay (Harvey and Goley 2011; Manugian 2013). Foraging often occurs in the Bay, as noted by observations of seals completing foraging behavior (i.e., short dives less than 5 minutes, moving back and forth within an area, and sometimes tearing up prey at the surface).

During 210 days of SFOBB monitoring beginning in 2002, 657 harbor seals were observed within 3,280 feet (1,000 meters) of the east span of the SFOBB. Harbor seals made up 90 percent of the marine mammals observed during monitoring for the SFOBB Project. Foraging near the SFOBB is common, particularly within the coves adjacent to the U.S. Coast Guard Station at YBI, and in Clipper Cove between YBI and Treasure Islands. Foraging also occurs within a shallow trench area southeast of YBI (Department 2013a, 2013b). These sites are approximately 2,297 to 4,593 feet (700 to 1,400 meters) west of Pier E3.

Harbor seals are present in the Bay year-round and use it for foraging, resting, and reproduction. Pacific harbor seals are the only species of marine mammal that breed and bear young in the Bay. Peak numbers of hauled-out harbor seals vary by haul-out site and

depend on the season. Results of a study of 39 radio-tagged harbor seals in the Bay found that the most active diving occurred at night. The feeding areas located closest to Pier E3 included Area 6 (just to the south of YBI) and Area 7 (north of Treasure Island, Figure 1). Mean haul-out periods ranged from 80 minutes to 24 hours (Harvey and Torok 1994).

Pupping season in the Bay begins in mid-March and continues until about mid-May. Pups nurse for only 4 weeks, and mating begins after pups are weaned. In the Bay, mating occurs from April to July, and the molting season is from June until August (Schoenherr 1995; Kopec and Harvey 1995). Twelve haul-out sites and rookeries are in the Bay, but only three sites in the Bay regularly host more than 40 harbor seals at any one time; these are Mowry Slough in the South Bay, YBI, and Castro Rocks in the Central Bay (Figure 1; Spencer 1997).

The YBI harbor seal haul-out site is located on a rocky beach on the southern side of YBI, immediately west of the lighthouse on the southernmost tip of the island (Figure 1) (Kopec and Harvey 1995). The maximum reported number of seals hauled out at one time is 344, counted in January 1992 (Kopec and Harvey 1995). The abundance of harbor seals at this site during the winter months likely coincides with the presence of spawning Pacific herring near the island. Re-sightings at the haul-out site indicate long-term usage of the site (Spencer 1997).

3.2.3. Northern Elephant Seal (California Breeding Stock)

Status: The northern elephant seal is protected under the MMPA, but it is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013), or listed as endangered or threatened under the FESA. The population size for the California breeding stock is estimated at 124,000 to 179,000 seals and is increasing (Lowry et al. 2010; Carretta et al. 2012).

Use of the San Francisco Bay and SFOBB Area: Generally, only juvenile elephant seals enter the Bay, and they do not remain long. The most recent sighting was in 2012, on the beach at Clipper Cove on Treasure Island, when a healthy yearling elephant seal hauled out for approximately one day. Approximately 100 juvenile northern elephant seals strand in the Bay each year, including individual strandings at YBI and Treasure Island (less than 10 seals per year).

3.2.4. Harbor Porpoises (San Francisco-Russian River Stock)

Status: Harbor porpoises that occur in the Bay are part of the San Francisco-Russian River stock. The harbor porpoise population has been increasing since 1993. The harbor

porpoise is not listed as endangered or threatened under the FESA, and it is not considered to be a strategic or depleted species under the MMPA. Census data suggest a stable population trend. The latest NMFS stock estimates for the San Francisco-Russian River stock is 9,189 porpoises (CV = 0.38). (Carretta et al. 2009)

Use of the San Francisco Bay and SFOBB Area: After a 60-year absence, harbor porpoises have returned to the Bay in recent years to forage (Keener et al. 2012). Harbor porpoises commonly were seen outside the Bay but rarely entered the Bay. This probably was because of mine fields and anti-submarine nets near the Golden Gate Bridge during World War II, pollution of the Bay, and high boat traffic. Most sightings have been in the western part of the Bay near the Golden Gate Bridge and Cavallo Point, with some sightings near Tiburon and Angel Island (Keener et al 2012). In 2009, researchers with Golden Gate Cetacean Research began a multi-year assessment to document the Bay harbor porpoise population. The Golden Gate Cetacean Research team compiled a catalog of 225 individuals that were observed inside the Bay (Stern, pers. comm., 2011).

3.2.5. Extralimital or Rare Species

Extralimital species currently do not enter the Bay regularly but may occur sporadically in the Bay or strand in the Bay, and some species may occur only seasonally. These species are mentioned because they infrequently enter the Bay and, although very unlikely, may be near Pier E3 during implosion activities.

3.2.5.1. COMMON BOTTLENOSE DOLPHIN (CALIFORNIA COASTAL STOCK)

The common bottlenose dolphin is protected under the MMPA, but it is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013), or listed as endangered or threatened under the FESA. Bottlenose dolphin has begun only recently to enter the Bay. Movements primarily have been just east of the Golden Gate Bridge and along the west coastline of the Bay, south to Redwood City (Stern, pers. comm., 2011). Bottlenose dolphin has not been observed in the vicinity of the SFOBB Project. As its population becomes more established in the waters off northern California, the species may venture into other areas of the Bay.

3.2.5.2. SOUTHERN SEA OTTER (CALIFORNIA POPULATION)

The southern sea otter (*Enhydra lutris*) is protected under the MMPA and is listed as threatened under the FESA (Carretta et al. 2012). Sea otters are common in the near-shore waters from Point Conception to Half Moon Bay. Sea otters are not regular visitors to the Bay, but several have been observed in the Bay in the last decade (De Rango, pers. comm., 2013).

3.2.5.3. NORTHERN FUR SEAL (CALIFORNIA STOCK)

The northern fur seal (*Callorhinus ursinus*) is protected under the MMPA and is not listed as a depleted or strategic stock under the MMPA (Carretta et al. 2012). Northern fur seals are not listed as threatened or endangered under the FESA. Northern fur seals are not regular visitors, but several have stranded in the Bay since the 1980s (De Rango, pers. comm., 2013).

3.2.5.4. GRAY WHALE (EASTERN NORTH PACIFIC)

The gray whale is protected under the MMPA, but it is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013), or listed as endangered or threatened under the FESA. Reports from the MMC indicate that, since 1999, gray whale sightings in the Bay have become more common with at least two to six whales entering the Bay annually. Most gray whale sightings have occurred during the spring migration north. No whales have been sighted near the east span of the SFOBB, reports have been made of whales at the north end of Treasure Island during March, and one sighting about 1,000 yards (0.6 mile) south of YBI in February (Thorson, pers. comm., 2014).

3.2.5.5. HUMPBACK WHALE (CALIFORNIA/OREGON/WASHINGTON STOCK)

The humpback whale (*Megaptera novaeangliae*) is protected under the MMPA and is listed as a depleted and strategic stock under the MMPA (Carretta et al. 2012). Humpback whale is listed as endangered under the FESA. Several reports exist of humpback whales entering the Bay and heading up the Delta waterway. The most recent occurrence was in 2007, when an injured mother and calf entered the Bay for 7 days (Gulland et al. 2008).

3.2.5.6. MINKE WHALE (CALIFORNIA/OREGON/WASHINGTON STOCK)

The minke whale (*Balaenoptera acutorostrata scammoni*) is protected under the MMPA and is not listed as a depleted or strategic stock under the MMPA (Carretta et al. 2012). Minke whale is not listed as threatened or endangered under the FESA. Minke whales are not regular visitors to the Bay but have been observed several times since the 1980s (De Rango, pers. comm., 2013).

3.2.5.7. SPERM WHALE (CALIFORNIA/OREGON/WASHINGTON STOCK)

The sperm whale (*Physeter macrocephalus*) is protected under the MMPA and is listed as a depleted and strategic stock under the MMPA (Carretta et al. 2012). Sperm whale is listed as endangered under the FESA. Sperm whales are not regular visitors to the Bay and have been observed once since the 1980s (De Rango, pers. comm., 2013).

3.2.5.8. FIN WHALE (CALIFORNIA/OREGON/WASHINGTON STOCK)

The fin whale (*Balaenoptera physalus physalus*) is protected under the MMPA and is listed as a depleted and strategic stock under the MMPA (Carretta et al. 2012). Fin whale is listed as endangered under the FESA. Fin whales are not regular visitors to the Bay and have been observed once since the 1980s (De Rango, pers. comm., 2013).

3.2.5.9. STELLER SEA LION (EASTERN STOCK, CALIFORNIA POPULATION)

The Steller sea lion (*Eumetopias jubatus*) is protected under the MMPA and is not listed as a depleted and strategic stock under the MMPA (Allen and Angliss 2013). The Steller sea lion western distinct population segment (DPS) is listed as endangered under the FESA. From 1982 to 2009, the population of Steller sea lions using central California (Año Nuevo and the Farallon Islands) has been relatively stable or slowly decreasing to approximately 2,781 in 2011 (Allen and Angliss 2013). Steller sea lions are not regular visitors to the Bay, but several animals have stranded in the Bay since the 1980s (De Rango, pers. comm., 2013).

3.2.5.10. SHORT-BEAKED COMMON DOLPHIN (CALIFORNIA/OREGON/WASHINGTON STOCK)

The short-beaked common dolphin (*Delphinus delphis delphis*) is protected under the MMPA and is not listed as a depleted or strategic stock under the MMPA (Carretta et al. 2012). Common dolphin is not listed as threatened or endangered under the FESA. The short-beaked common dolphin is the most abundant cetacean in California waters, although it tends to be found further offshore. Only one short-beaked common dolphin stranding has been reported in the Bay since the 1980s (De Rango, pers. comm., 2013).

3.3. Mechanical Dismantling Monitoring for Marine Mammals

Mechanical dismantling of Pier E3, including removal of the pier cap and the fender apron, and drilling of boreholes for loading controlled charges will be monitored for impacts on marine mammals as identified in the SFOBB Project's July 2015 IHA. Under this IHA, the Department is required to visually monitor 20 percent of mechanical dismantling activities for the 120 decibels (dB) re 1 micro Pascal (µPa) Level B harassment zone. The distance to this zone is established at 6,561 feet (2,000 meters) in the IHA, but this may be adjusted after real-time acoustic monitoring can determine actual sound exposures.

If mechanical dismantling activities, including drilling of boreholes, generate underwater sound pressure levels higher than 180 dB (root mean square [RMS]) and 190 dB (RMS) re 1 µPa for cetaceans and pinnipeds, respectively, exclusion zones will be established.

Sound-generating activities must be powered down or shut down if a marine mammal is observed within the established exclusion zones.

Monitoring will follow the criteria outlined in the 2013 Marine Mammal Monitoring Plan. Marine mammal monitors will begin monitoring 30 minutes before the start of the activities, monitoring throughout all construction activities, and continuing for 30 minutes after construction has ended. Observers will use binoculars to confirm observations and will have cell phones or radios to maintain contact with other observers or Department engineers. Further details on data collection requirements and reporting procedures are discussed in the SFOBB Project's July 2015 IHA.

3.4. Implosion Monitoring for Marine Mammals

3.4.1. Impulse Sound Threshold Criteria for Marine Mammals

Demolition activities associated with the use of controlled charges for underwater implosion have the potential to result in the incidental take of marine mammals. In late 2013, NMFS established interim impulse sound threshold criteria for marine mammals from underwater implosion events (Table 1).

3.4.2. Threshold Criteria Distances from Controlled Charges

The propagation of underwater noise is affected by various environmental conditions, including bathymetry, sea state, currents, temperature, presence of fish schools and/or phytoplankton blooms/algae, and other physical or biological factors. The Department modeled underwater sound pressure levels (SPLs) and cumulative sound exposure levels (SELs) for the Pier E3 implosion. This analysis was used to determine the distance to the Level A, Level B, and mortality thresholds for key species (Table 2). Details of the acoustic modeling procedure are available in the Department's IHA application that was submitted to NMFS (Department 2015a).

3.4.2.1. INCIDENTAL HARASSMENT AUTHORIZATION

The September 2015 IHA allows for the take of 12 Pacific harbor seals, two California sea lions, two northern elephant seals, and two harbor porpoise by Level B Harassment—Behavioral Response. The IHA also allows for take of six Pacific harbor seals by Level B Harassment—Temporary Threshold Shift (TTS). No Level B Harassment—TTS take of California sea lion, northern elephant seal, or harbor porpoise is allowed (Table 3).

Table 1. Underwater Impulse Noise Threshold Criteria for Marine Mammals

Group	Species	Behavior		Slight Injury			Mortality
		Behavioral (for ≥ 2 pulses/ 24 hours)	TTS	PTS	Gastro Intestinal Tract	Lung	
Low-frequency Cetaceans	Mysticetes	167 dB SEL (LF_{II})	172 dB SEL (LF_{II}) or 224 dB peak SPL	187 dB SEL (LF_{II}) or 230 dB peak SPL	237 dB SPL or 104 psi	$39.1\ M^{1/3}\ (1+[D_{Rm}/10.081])^{1/2}$ Pa-sec Where: M = mass of the animals in kg D_{Rm} = depth of the receiver (animal) in meters	$91.4\ M^{1/3}\ (1+[D_{Rm}/10.081])^{1/2}$ Pa-sec Where: M = mass of the animals in kg D_{Rm} = depth of the receiver (animal) in meters
Mid-frequency Cetaceans	Most delphinids, medium and large toothed whales	167 dB SEL (MF_{II})	172 dB SEL (MF_{II}) or 224 dB peak SPL	187 dB SEL (MF_{II}) or 230 dB peak SPL			
High-frequency Cetaceans	Porpoises and *Kogia* spp.	141 dB SEL (HF_{II})	146 dB SEL (HF_{II}) or 195 dB peak SPL	161 dB SEL (HF_{II}) or 201 dB peak SPL			
Phocidae	Hawaiian monk, elephant, and harbor seal	172 dB SEL (P_{WI})	177 dB SEL (P_{WI}) or 212 dB peak SPL	192 dB SEL (P_{WI}) or 218 dB peak SPL			
Otariidae	Sea lions and fur seals	195 dB SEL (O_{WI})	200 dB SEL (O_{WI}) or 212 dB peak SPL	215 dB SEL (O_{WI}) or 218 dB peak SPL			

Note:
All decibels are referenced to 1 micro Pascal (re: 1µPa)
Source: NOAA 2013

Table 2. Estimated Distances to NMFS Marine Mammal Impulse Criteria for Level B Harassment, Level A Harassment, and Mortality from the Pier E3 Implosion

Species	Level B Criteria		Level A Criteria			Mortality
	Behavioral Response	Temporary Threshold Shift	Permanent Threshold Shift	GI Track	Lung Injury	
Pacific Harbor Seal	9,700 ft (2,957 m)	5,700 ft (1,737 m)	1,160 ft (354 m)	35 ft (11 m)	450 ft (137 m)	205 ft (63 m)
Northern Elephant Seal	9,700 ft (2,957 m)	5,700 ft (1,737 m)	1,160 ft (354 m)	35 ft (11 m)	450 ft (137 m)	205 ft (63 m)
California Sea Lion	800 ft (244 m)	470 ft (143 m)	245 ft (75 m)	35 ft (11 m)	450 ft (137 m)	205 ft (63 m)
Harbor Porpoise	44,500 ft (13,564 m)	26,500 ft (8,077 m)	5,800 ft (1,768 m)	35 ft (11 m)	450 ft (137 m)	205 ft (63 m)

Note:
A BAS with 80 percent efficiency in acoustic attenuation is assumed for the implosion. The largest criteria distance (i.e., more conservative) is presented.
Source: NOAA 2015

Table 3. Marine Mammal Take Allowed under IHA		
Species	**Level B Take**	
	Behavioral	**TTS**
Pacific harbor seal	12	6
California sea lion	2	0
Northern elephant seal	2	0
Harbor porpoise	2	0
Source: NOAA 2015		

3.4.3. Pre-Implosion Briefing

Before the implosion of Pier E3, a briefing will be held between the construction supervisors, construction crew, marine mammal monitoring team, acoustical monitoring team, and Department staff. The purpose of the briefing will be to establish the responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures. The Blaster-in-Charge and Resident Engineer will have the authority to stop or delay any demolition activity, if deemed necessary.

3.4.4. Establishment of Marine Mammal Exclusion and Behavioral Response Zones

Before implosion of Pier E3, a 1,160-foot (354 meter) Pacific harbor seal and California sea lion exclusion zone (see footnote in Table 4), a 5,700-foot (1,737 meter) northern elephant seal exclusion zone, and a 26,500-foot (8,077 meter) harbor porpoise exclusion zone will be established (Table 4 and Figures 2 and 3). The Marine Mammal Exclusion Zones (MMEZs) will include all areas where the underwater SPLs or SELs are anticipated to equal or exceed the Level A threshold criteria for harbor seal and the TTS criteria for sea lion, elephant seal, and harbor porpoise.

A 5,700-foot (1,737 meter) Level B Harassment—TTS monitoring zone will be established for harbor seals (Table 4 and Figure 2). A 9,700-foot (2,957 meter) Level B Harassment—Behavioral Response monitoring zone will be established for pinnipeds (i.e., harbor seal, sea lion, and elephant seal) (Table 4 and Figure 2). A 44,500-foot (13,564 meter) Level B Harassment—Behavioral Response monitoring zone will be established for harbor porpoise (Table 4 and Figure 3).

Table 4. Exclusion and Monitoring Zones

Species	Exclusion Zone	Monitoring Zone	
		TTS	Behavioral Response
Pacific harbor seal	1,160 feet (354 meters)	5,700 feet (1,737 m)	9,700 feet (2,957 meters)
California sea lion*	1,160 feet (354 meters)	No TTS take is allowed. Area is included in Exclusion Zone	9,700 feet (2,957 meters)
Northern elephant seal	5,700 feet (1,737 meters)		9,700 feet (2,957 meters)
Harbor porpoise	26,500 feet (8,077 meters)		44,500 feet (13,564 meters)

Note:
The IHA requires a 470-foot (143 meter) exclusion zone and an 800-foot (244 meter) Level B Harassment—Behavioral Response monitoring zone for California sea lion. As these zones are in the near-field of the implosion, the Department has elected to monitor a large exclusion zone and Level B Harassment—Behavioral Response monitoring zone for this species.
Source: NOAA 2015

3.4.5. Monitoring Plan

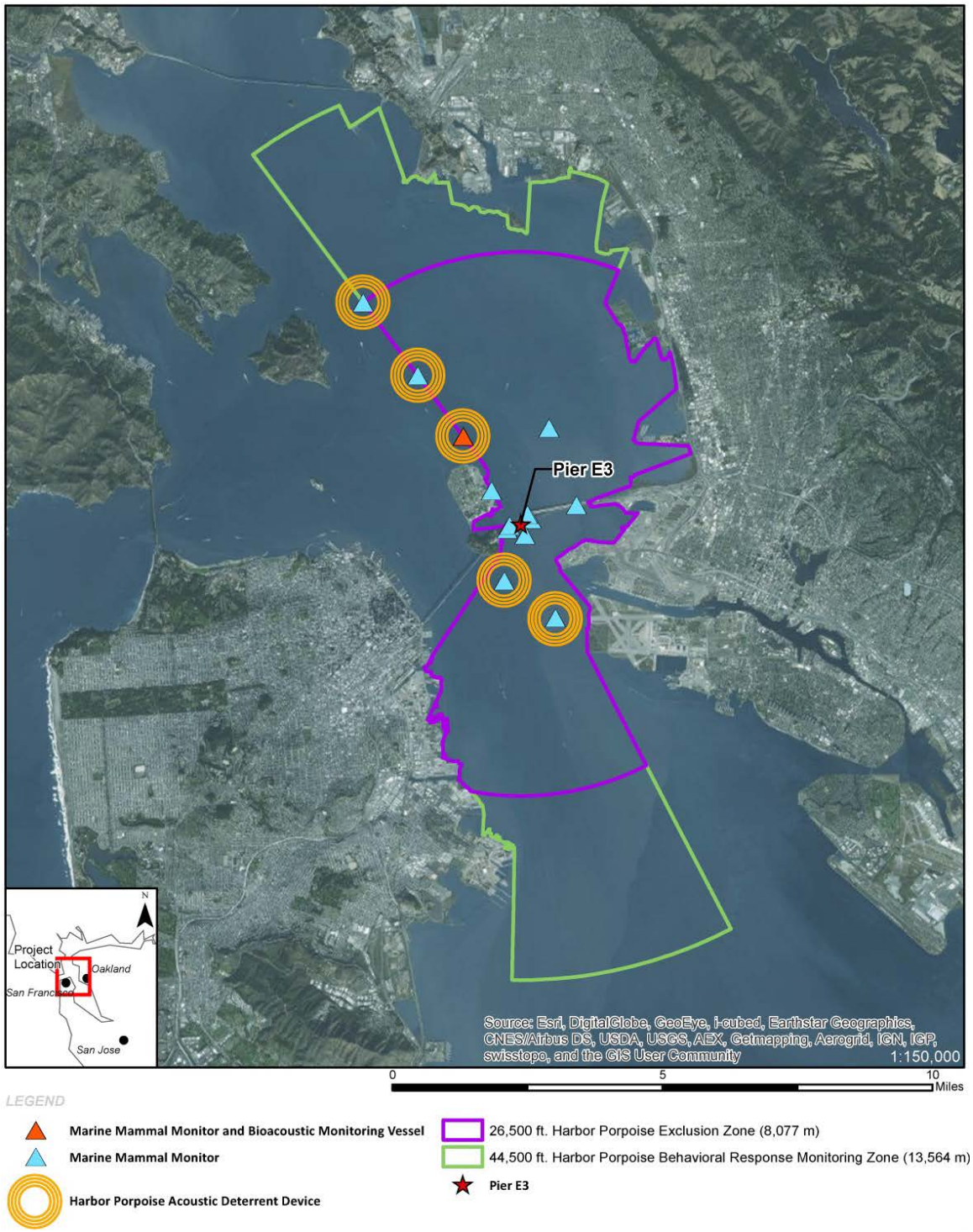
Monitoring for potential impacts on marine mammals from the implosion event mainly will be based on the current SFOBB Project pile driving monitoring protocol. Pile driving has been conducted for the SFOBB Project since 2002. During this time, marine mammal monitoring has been conducted under several NMFS-approved marine mammal monitoring plans (Department 2002, 2004, 2013a). Most elements of these marine mammal monitoring plans (e.g., exclusion zones) are similar to what is required for underwater implosions. This monitoring plan includes the exclusion and behavioral monitoring zones previously identified in Section 3.4.4, which is based on the hydroacoustic modeling of NMFS acoustic threshold criteria and requirements of the September 2015 IHA (NOAA 2015a).

The following describes the specific elements of the monitoring plan, including demarcation of the MMEZs and other monitored zones where marine mammal observers (MMO) may be positioned, communications protocol, and a project-specific stranding plan.

Marine Mammal Exclusion Zones: The MMEZs identified in Section 3.4.4 will be established so that monitoring will result in complete avoidance of Level A take of all marine mammals and avoidance of Level B Harassment—TTS take of sea lion, elephant seal, and harbor porpoise. The Level A exclusion zone for harbor seal is 1,160 feet (354 meters) or the modeled distance to 192 dB SEL. The IHA required exclusion zone for TTS exposure to sea lions is 470 feet or the modeled distance to 215 dB SEL; however, the Department has elected to monitor a larger 1,160 feet (354 meters) exclusion zone for sea lion, consistent with the harbor seal exclusion zone. The exclusion zone for TTS

Source: AECOM

Figure 2. Pinniped Exclusion and Behavioral Response Zones



Source: AECOM

Figure 3. Harbor Porpoise Exclusion and Behavioral Response Zones

exposure to elephant seal is 5,700 feet (1,737 meters) or the modeled distance to 177 dB SEL. The exclusion zone for TTS exposure to harbor porpoise will extend out 26,500 feet (8,077 meters) from Pier E3 or the modeled distance to 145 dB SEL.

The MMEZs will be monitored by MMOs, and if any marine mammals are observed inside the MMEZs, the implosion will be delayed until the animal leaves the area or at least 30 minutes have passed since the last observation of the animal. Anticipated dry land, bridge, and boat locations where MMOs will be positioned are shown in Figures 2 and 3. The presence of harbor porpoise in the exclusion zone is unlikely, but monitoring, including the real-time acoustic monitoring discussed in Section 3.6, will be employed to confirm its presence or absence.

Level B Harassment—TTS and Behavioral Response Monitoring Zones: The marine mammal monitoring zones identified in Section 3.4.4 will be established to identify the number of harbor seals taken by Level B Harassment—TSS and Behavioral Response, and the number of sea lions, elephant seals, and harbor porpoise taken by Level B Harassment—Behavioral Response.

For harbor seal, the monitoring zone for TTS exposure will extend out 5,700 feet (1,737 meters) from Pier E3 or the modeled distance to 177 dB SEL. The monitoring zone for Behavioral Response in harbor seal, sea lion and elephant seal will extend out 9,700 feet (2,957 feet) from Pier E3 or the modeled distance to 172 dB SEL. For sea lion, the distance to the Level B Harassment—Behavioral Response zone is 800 feet (244 meters) from Pier E3 or the distance to 195 dB SEL. The Department has elected to monitor a large Level B Harassment—Behavioral Response zone for sea lion, consistent with the monitoring zone for harbor seal and elephant seal. The presence of harbor porpoise in this area is unlikely but monitoring, including real-time acoustic monitoring, discussed in Section 3.6 will be employed to confirm its presence or absence. The monitoring zone for Behavioral Response exposure to harbor porpoise will extend out 44,500 feet (13,564 feet) from Pier E3 or the modeled distance to 141 dB SEL.

Marine Mammal Observers: A minimum of 10 NMFS-approved MMOs are required by the IHA during the Pier E3 controlled implosion; however, the Department has elected to employ a minimum of 13 MMOs so that the MMEZs, Level B Harassment—TTS and Behavioral Response zones can be monitored. MMOs will be positioned near the edge of each of the pinniped threshold criteria zones and within the large harbor porpoise exclusion zone, using boats, barges, bridge piers, and roadway, as well as sites on YBI and Treasure Island. Anticipated locations for MMOs are shown in Figures 2 and 3. One

MMO will be designated as the lead MMO and will be located near or in constant communication with the Lead Biological Monitor who will be with the Department Resident Engineer during the implosion. The lead MMO will receive updates from other MMOs on the presence or absence of marine mammals within the MMEZs and will notify the Lead Biological Monitor of cleared MMEZs before the implosion.

Monitoring Protocol: Implosion of Pier E3 will be conducted only during daylight hours and with enough time for pre- and post-implosion monitoring. The implosion will occur during good weather (i.e., clear skies and no high winds) so that the MMOs will be able to detect marine mammals within the MMEZs and beyond. The lead MMO will be in contact with other MMOs and the acoustic monitors. As the time for the implosion approaches, any marine mammal sightings will be discussed between the lead MMO, the Lead Biological Monitor and the Department Resident Engineer. If any marine mammals enter the MMEZs within 30 minutes of blasting, the lead MMO will notify the Lead Biological Monitor and Resident Engineer that the implosion may need to be delayed. The lead MMO will keep them informed of the disposition of the animal. If the animal remains in the MMEZs, blasting will be delayed until it has left the MMEZs. If the animal dives and is not seen again, blasting will be delayed at least 30 minutes from the time the animal was last sighted. After the implosion has occurred, the MMOs will continue to monitor the area for at least 60 minutes.

Although any injury or mortality to marine mammals from the implosion of Pier E3 is very unlikely, boat or shore surveys will be conducted for 3 days following the event to determine whether any injured or stranded marine mammals are in the area. If an injured or dead animal is discovered during these surveys or by other means, the NMFS-designated stranding team will be contacted to pick up the animal. Veterinarians will treat the animal or will conduct a necropsy to attempt to determine whether it was stranded or injured by the Pier E3 implosion.

Data Collection: Each MMO will record his/her observation position, start and end times of observations, and weather conditions (e.g., sunny/cloudy, wind speed, fog, visibility). For each marine mammal sighting, the following items will be recorded, if possible:

1. Species
2. Number of animals (i.e., with or without pup/calf)
3. Age class (i.e., pup/calf, juvenile, adult)

4. Identifying marks or color (e.g., scars, red pelage, damaged dorsal fin)

5. Position relative to Pier E3 (i.e., distance and direction)

6. Movement (i.e., direction and relative speed)

7. Behavior (e.g., logging [resting at the surface], swimming, spy-hopping [raising above the water surface to view the area], foraging)
   [Signs of injury, stress, or other unusual behavior also will be noted.]

8. Duration of sighting or times of multiple sightings of the same individual

Communication: All MMOs will be equipped with mobile phones and/or radios. One person will be designated as the lead MMO and will be in constant contact with the Lead Biological Monitor who will be with the Department Resident Engineer . The lead MMO will coordinate marine mammal sightings with the other MMOs. MMOs will contact the other MMOs when a sighting is made within the MMEZs or near the MMEZs so that the MMOs within overlapping areas of responsibility can continue to track the animal and the lead MMO is aware of the animal. If the sighting is within 30 minutes of blasting and an animal has entered the MMEZs or is near it, the lead MMO will notify the Lead Biological Monitor. The lead MMO will keep them informed of the disposition of the animal.

3.5. Real-Time Acoustic Monitoring

Although harbor porpoises are not expected to be in the Demonstration Project area (within 44,500 feet [13,564 meters] of the Behavioral Response zone) in November, real-time acoustic monitoring to confirm species absence and active monitoringwill be performed by trained observers. Harbor porpoises vocalize frequently with other animals in their group, and they use echolocation to navigate and to locate prey. Therefore, real-time acoustic monitoring can be used to detect this species as a supplement to visual monitoring.

Harbor porpoise generally are observed near the entrance to the Bay between the Golden Gate Bridge, Tiburon, Angel Island, the north side of the west span of the Bay Bridge and west side of Treasure Island. Two bio-acousticians will perform real-time acoustic monitoring within the 26,500-foot (8,077-meter)-radius harbor porpoise exclusion zone north of the east span of the SFOBB. An MMO also will be present on the acoustic monitoring boat to perform visual monitoring. A high-frequency hydrophone, calibrated to detect harbor porpoise, will be towed from the monitoring boat. All acoustic

monitoring equipment will be calibrated and tested before the implosion to check functionality.

Acoustic monitoring will start at sunrise on the morning of the implosion and will continue through the implosion and for at least 60 minutes following the implosion. The acoustic monitoring boat will transit throughout the northern portion of the harbor porpoise exclusion zone, north of the east span of the SFOBB. Acoustic and visual monitoring efforts will focus on deeper water areas north of Treasure Island, near the western edge of the harbor porpoise exclusion zone, because this is the most likely area of the exclusion zone to be visited by a transiting harbor porpoise. The acoustic monitoring equipment will not be able to give an accurate location for the detected animals but will provide a relative distance and direction so that the MMOs can search for the animals and determine whether those animals have entered or may enter the exclusion zone. If a harbor porpoise is detected either through audible “clicks” or visually before the implosion, the lead MMO will be notified immediately. On detection of clicks, the acoustic monitoring boat will travel in the direction of the detected animal to confirm its location visually. If the animal is confirmed to be within the exclusion zone, the lead MMO will notify the Lead Biological Monitor, who will notify the Department Resident Engineer to delay the implosion. The animal will be tracked and once outside of the exclusion the implosion will proceed as planned. If the animal cannot be visually located, the implosion will be delayed for 30 minutes after the last click is detected.

3.6. Acoustic Deterrent Devices

Acoustic deterrent devices (ADDs) commonly are used in commercial fishing and at fish farms to scare marine mammals away from nets or structures to prevent predation on fish, but they have not been used during blasting to minimize impacts. These devices will supplement the visual monitoring, to deter marine mammals from entering the MMEZs before and during the implosion. The pulse of the ADDs may range in frequency from 4 to 41 kHz, at sound levels of 110 to 200 dB with regular or random interpulse intervals of 4 to 90 seconds (Gordon et al. 2003; Brandt et al. 2013; Götz and Janik 2013; Schakner and Blumstein 2013). ADDs have typical effective ranges of 328 feet (100 meters) to 6.28 mi (10 km), depending on the source level and frequency of the ADD, and the environmental conditions (e.g., water temperature, salinity, bottom depth, type of substrate). An estimated two ADDs may be deployed near the harbor seal and sea lion exclusion zone before the Pier E3 implosion. These ADDs will have an effective range of approximately 0.31 to 1.25 mi (0.5 to 2.0 km), depending on the species affected.

Marine mammals may habituate to ADDs over time, because nets or fish farms are a regular source of food. Harbor seals in the Bay have not been observed feeding around bridge piers but have been observed foraging in the eelgrass beds near YBI, which is outside the harbor seal and sea lion exclusion zone. Harbor seals and sea lions around Pier E3 have been observed swimming north or south through the area, likely towards the haul-out on YBI, or to foraging areas elsewhere in the Bay. It is likely that marine mammals, particularly harbor seals that are resident to the Bay, have never encountered ADDs and therefore, the ADDs will be an effective deterrent for the short time they may be used before detonation (1 to 2 days, for several hours each day). Several ADDs can be attached to buoys or other bridge piers further away from Pier E3 to deter marine mammals from entering the monitoring area. The ADDs will be set several hundred meters out from the Pier E3 site, for the safety of the biologists deploying the ADDs. The exact locations of the ADDs will be determined based on field activities, available structures and locations of existing boats and buoys. The ADDs will have an effective range of approximately 1,640 feet (500 meters) for pinnipeds and will deter seals or sea lions from the 1,160-foot (354-meter) Level A and mortality threshold areas. The effective range of the ADDs for the high-frequency cetaceans will be approximately 300 feet (91 meters) and may be used to deter harbor porpoises from entering the 26,500-foot (8,077-meter) harbor porpoise exclusion zone.

3.7. Stranding Plan

A stranding plan will be prepared, in cooperation with the NMFS-designated marine mammal stranding, rescue, and rehabilitation center for central California. Although avoidance and minimization measures are likely to prevent any injuries from the implosion, preparations will be made in the unlikely event that marine mammals are injured. In addition, it will be necessary to determine the cause of stranding for any marine mammals that appear within 3 days after the implosion. Sick, injured, or dead marine mammals often strand in the Bay because of the large number of marine mammals, primarily pinnipeds, which inhabit or regularly use the Bay. Therefore, sick or injured individuals observed after the implosion may need to be examined more thoroughly to determine the cause of the stranding.

Elements of the stranding plan to be implemented are as follows:

1. A stranding center crew and a veterinarian will be on call near the Pier E3 site at the time of the implosion to quickly recover any injured marine mammals, provide emergency veterinary care, stabilize the animal’s condition, and transport individuals to the stranding facility. If an injured or dead animal is found, NMFS

(both the regional office and headquarters) will be notified immediately, even if the animal appears to be sick or injured from a cause other than the implosion.

2. The stranding center crew will prepare treatment areas at the facility for cetaceans or pinnipeds that may be injured by the implosion. Preparation will include equipment to treat lung injuries, auditory testing equipment, dry and wet caged areas to hold animals, and operating rooms if surgical procedures are necessary. The stranding center regularly treats sick and injured marine mammals, so all of the facilities and equipment are ready at all times. Equipment to conduct auditory brainstem response hearing testing will be available to determine whether any inner ear threshold shifts (TTS or Permanent Threshold Shift) have occurred (Thorson et al. 1999).

3. Any veterinarian procedures, euthanasia, rehabilitation decisions and time of release or disposition of the animal will be at the discretion of the stranding center staff and the veterinarians treating the animals. Any necropsies to determine whether the injuries or death of an animal was the result of the implosion or other anthropogenic or natural causes will be conducted at the stranding center by the crew and veterinarians. The results will be communicated to the Department and NMFS as soon as possible, followed by a written report within a month.

4. Post-implosion surveys will be conducted immediately after the event and over the following 3 days to determine whether any injured or perished marine mammals are in the area.

3.8. Reporting

The NMFS Southwest Regional Administrator will be notified before the implosion activities for the Demonstration Project, and coordination with NMFS will occur on a weekly basis, or as often as necessary.

A monitoring report will be submitted to NMFS within 90 days after the event. The report will detail the monitoring protocol, summarize the data recorded during monitoring, and estimate of the number of marine mammals that may have been behaviorally harassed as a result of the implosion activities.

Chapter 4. Avian Monitoring Plan

The SFOBB Project Final Environmental Impact Statement (FEIS) and regulatory agency approvals obtained from the U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), and the San Francisco Bay Conservation and Development Commission (BCDC) specifically addressed potential impacts on birds from the SFOBB Project. The May 2001 FEIS identified that removal of the original bridge can result in temporary impacts on western gull (*Larus occidentalis*), double-crested cormorants (*Phalacrocorax auritus*), and American peregrine falcon (*Falco peregrinus*). On October 29, 2001, the Department received Biological Opinion 1-1-02-F-0002 from USFWS on the effects of the action on the California least tern (*Sterna antillarum browni*) and California brown pelican (*Pelecanus occidentalis californicus*). the Department received CDFW Incidental Take Permit (ITP) No. 2081-2001-021-03 on November 19, 2001, to cover SFOBB Project effects on protected fish and bird species listed as fully protected under the California Fish and Game Code (CFGC; i.e., California least tern, California brown pelican, and peregrine falcon). The formerly state and federally endangered California brown pelican was de-listed from both the FESA and the California Endangered Species Act (CESA) in 2009. The formerly state and federally endangered American peregrine falcon was de-listed from FESA in 1999, and was de-listed from the CESA in 2008.

Pursuant to the CDFW ITP, the Department is required to produce a Bird Management Plan to address bird management and monitoring during the SFOBB Project. In compliance with the CDFW permit requirement, the Department prepared the final (revised) Bird Monitoring and Management Plan (BMMP), which outlined the bird monitoring and management associated with construction of the new SFOBB east span (Department 2003). In addition to the protected species identified in the CDFW and USFWS approvals, the Department also identified the double-crested cormorant (*Phalacrocorax auritus*), western gull (*Larus occidentalis*), and other birds covered under the Migratory Bird Treaty Act (MBTA) and the CFGC that may nest in the project area, for monitoring. Per the 2001 FEIS, regulatory approvals, and BMMP, the Department is responsible for:

- Monitoring of active construction areas during pile driving, dredging, and general construction activities to assess potential effects on the five target bird species;
- Monitoring of peregrine falcon nests to assess the potential effects on the species from construction activities;

- Nest surveys on YBI by a Department biologist before vegetation removal; and
- A bird management strategy that briefly outlines avoidance and minimization measures and scheduling guidelines to help avoid the take of (and minimize adverse effects on) birds (e.g., least tern, peregrine falcon, double-crested cormorant, western gull) that nest on the SFOBB.

The primary objective of these efforts is to document any take of these species resulting from construction activities. Since 2002, bird monitoring has been performed by boat for 3 hours per week by qualified avian biologists who survey in, and around the SFOBB Project area. In addition, the Department has conducted annual peregrine falcon monitoring since 2003.

The BMMP requires the development of "a plan designed to minimize adverse impacts … [on peregrine falcons, least tern, double-crested cormorants, and western gulls] …within known nesting areas on the existing bridge ... prior to the beginning of dismantling activities." The Department Bird Management Plan for Bridge Dismantling (BMP) fulfills both the requirements of the BMMP and regulatory agency approvals (Department 2013c). The BMP details the management strategy during the removal of the original east span, including deterrence of nesting birds and procedures to follow in the event that an occupied nest is found in the work area. The Department has been conducting nesting bird monitoring during mechanical dismantling activities since June 2015 and will continue to follow protocols provided in the BMP, to avoid impacts on nesting birds during the mechanical dismantling and drilling of the Pier E3 marine foundation.

However, the SFOBB Project's FEIS, regulatory authorizations, and bird management plans did not consider potential impacts on avian species as a result of removing marine foundations through controlled implosion. This Avian Monitoring Plan (AMP) is designed to provide the necessary direction so that impacts on protected avian species from the mechanical dismantling and controlled implosion of Pier E3 are avoided.

4.1. Avian Species of Concern

4.1.1. Peregrine Falcon

Prior to 1999, peregrine falcon was identified as a state and federally listed species. USFWS de-listed peregrine falcon from the FESA in 1999, and CDFW de-listed it from the CESA in 2008. Peregrine falcon is recognized as "fully protected" by CDFW, is

identified federally as a "Bird of Conservation Concern," and is protected under the MBTA.

Peregrine falcon is a year-round resident in the project area. Its nesting season is from February through July. Peregrine falcon was known to nest on the east span of the Bay Bridge before SFOBB Project construction. Observations of an established, historic peregrine falcon territory east of YBI have been made since the mid-1980s. This territory is centered on the original east span cantilever structure. Since the Department initiated peregrine falcon monitoring in 2003, peregrine falcon has been observed nesting on the cantilever structure at various locations from Piers E2 to E4 and within the 504-foot truss spans on Pier E8. Exclusionary deterrents have been, and continue to be installed on the original east span, with the goal of deterring peregrine falcon from nesting while it is being dismantled.

A peregrine falcon pair nested in a recess on the Pier E8 tower leg during the 2014 and 2015 nesting seasons. During the nesting season, peregrine falcons may be observed perching at multiple locations or flying throughout the project area; however, activity generally is centered on the nest site. During the non- nesting season, peregrine falcons often are seen perched atop bridge towers, on sign posts, below the lower deck, or on the horizontal cross-beams at the top of Piers E2 through E8. However, Piers E2 and E3 will be removed prior to November 2015, and use of the remaining sites may be changed because of bridge removal activities.

4.1.2. California Brown Pelican

Brown pelican was listed formerly as an endangered species under the CESA and the FESA, because of population declines associated with pesticide residues in the environment. Brown pelican was de-listed from the CESA and the FESA in 2009; however, it still is protected under the MBTA, and its colonies are protected under the CFGC. CDFW includes brown pelican on its list of "fully protected" species.

Individual brown pelicans may be observed in the project area at any time of the year. However, brown pelican has not been documented as breeding in the project area or in the Bay. The Bay Area is not considered to be within the breeding range of the species. Nesting season for brown pelican is from January through July. Individuals observed in the project area during the nesting season are sub-adults or adult non-breeders.

In the SFOBB Project area, brown pelicans usually are observed singly or in small groups of less than five individuals. Brown pelicans use bridge piers for perching, often in close

proximity to construction activities. Brown pelicans also may be observed sitting on the water, actively feeding, or flying through the project area.

4.1.3. California Least Tern

Least tern is federally and state-listed as endangered under the FESA and CESA, and also is protected under the MBTA and is fully protected by the CFGC. During bird monitoring conducted from 2002 to 2013, least terns were observed only during the nesting season (April through August), foraging primarily south of the Oakland Touchdown, in the Port of Oakland Outer Harbor. Least tern observations consistently have occurred near the shore, towards the various marinas and harbors along the waterfront of the East Bay. During this time, monitors have made no observations of least terns foraging off the eastern side of YBI or near Pier E3.

A large colony of least terns nests annually at the Naval Air Station in Alameda, approximately 3 miles from the project area. As stated above, the nesting season for least tern is from April through August. For the rest of the year, California least tern is absent from the Bay Area. During that time, it is in its winter range, which includes the Central and South America Pacific coasts.

4.1.4. Double-Crested Cormorant

Double-crested cormorant is protected under the MBTA and CFGC. The 2008 CDFW California Bird Species of Special Concern report includes double-crested cormorant nesting colonies in the “Taxa to Watch” list (Shuford and Gardali 2008).

Double-crested cormorants were first documented nesting on the original SFOBB east span in the early 1980s. This species nests colonially on the steel girders below the lower deck. The area occupied by nesting cormorants varies laterally each year, expanding and contracting around the colony’s core between Piers E7 and E10. The nesting season for cormorants is from March through August. The number of nests fluctuated from a high of 814 in 2007, to a low of 83 in 2009. In 2007, at its greatest recorded extent, the SFOBB colony extended from Pier E3 to Pier E16. During the non-nesting season, double-crested cormorants historically have used the structure of the original SFOBB east span for roosting. Some winter bridge surveys have found cormorants numbering in the thousands. In addition, double-crested cormorants often are observed perched, foraging, or in transit (singly or in groups) in the project area. No change is anticipated to occur in this trend of general use.

4.1.5. Western Gull

Western gull has no status under the FESA or CESA. Western gull is protected as a migratory bird under the MBTA and the CFGC. The nesting season for western gull is from March through August. Mated pairs may be observed perched together at a potential nest site for weeks prior to initiating nesting. Both male and female adults are involved in nest building. It takes several days before the first egg is laid. As many as three nests may be initiated before the pair chooses one to finish and use. Nests are constructed with a variety of materials, including dried grass, forbs, and woody debris. Egg-laying takes 4 to 6 days for a three-egg clutch. Incubation begins with the first egg, and hatching occurs 30 to 32 days later. Chicks fledge when they are 40 to 50 days old (Pierotti and Annett 1995).

Western gull is present in the SFOBB Project area year-round. Individuals may be extremely persistent in attempts to nest on the bridge or other suitable surfaces. In some cases, eggs may be laid without the presence of any nest or nesting materials. Nests are constructed on ledges or other wide surfaces, including the marine foundations, pilings, tower legs, and other locations where they are protected from terrestrial predators. Occasional pairings between western gull and glaucous-winged gull (*Larus glaucescens*) have been noted during the SFOBB Project. For management and monitoring purposes, these species are treated equally.

4.1.6. Other Protected Nesting Birds

Other migratory birds may nest, or have been documented nesting in the SFOBB Project area. While nesting, these species are protected under the MBTA and CFGC. Common species observed nesting include pigeon guillemot (*Cepphus columba*), house finch (*Carpodacus mexicanus*), and black phoebe (*Sayornis nigricans*).

4.2. Avian Monitoring during Pier E3 Mechanical Dismantling and Pre-implosion Activities

Mechanical dismantling of Pier E3; including the removal of the pier cap and fender apron, and drilling of boreholes for loading controlled charges; has been monitored, and continues to be monitored, for impacts on birds, in compliance with the methods outlined in the BMP. Dismantling of the pier cap started in June 2015, and was completed in August 2015. Drilling of boreholes to load controlled charges started in September 2015 and will be completed by the third week of October 2015. Following the completion of mechanical dismantling activities, the Department will initiate pre-implosion activities. These activities will include loading explosives into Pier E3 and installation of the Blast Attenuation System.

A majority of the mechanical dismantling activities occurred during the breeding season for most birds. The Department monitored the mechanical dismantling of Pier E3 for bird activity from the bike path on the new east span 5 days per week throughout the nesting season (February 1 to August 31). Avian monitoring was reduced to 1 day per week from September 1, 2015. Weekly avian monitoring of Pier E3 will continue until the pier is imploded in early November.

During nesting bird monitoring, the Department's biologists monitor for signs of breeding and nesting activities, including courtship, copulation, defending territories, gathering of nesting material, selecting nesting sites, nest building, foraging, caching food, and carrying food to young. Because of active construction occurring on the old bridge structure, the bird monitors are positioned on the bike path and inspect all structures on Pier E3 that are visible from the bike path and have the potential to support nesting birds. In addition, the Department is responsible for removing nest starts, unoccupied nests, and food caches; however, nest or food cache removal activities have not been necessary thus far.

4.3. Avian Monitoring During Implosion Event

Monitoring for birds immediately before and during the Pier E3 implosion primarily has been designed so that protected species will not be affected by harmful sound/pressure waves while diving or otherwise foraging in the water column. Because of sound's impedance at the air-water interface, impacts on birds will be limited to any individuals submerged during the implosion. The following sections describe the various elements of avian monitoring to be completed before, during, and after the implosion. Protected diving bird species include the California least tern and the brown pelican, however, neither of these birds are expected to be in the area in November in high numbers.

4.3.1. Establishment of the Avian Watch Zone

The establishment of a 500-foot (152-meter) watch zone around Pier E3 to protect diving birds reflects the modeled distance to a cumulative SEL of 202 dB during the implosion. See Figure 4. In 2012, the Washington Department of Transportation and USFWS established a regulatory threshold of 202 dB SEL for auditory injury and 208 dB SEL for non-auditory injury thresholds during in-water pile driving for marbled murrelets (WSDOT 2014). Use of the auditory injury threshold (i.e., 202 dB SEL) to avoid impacts on protected diving birds during the Pier E3 implosion has been designed to maintain consistency with past projects where measures were taken to protected avian species.

Source: AECOM

Figure 4. Avian Monitoring Locations and Watch Zone

4.3.2. Avian Deterrents

Auditory deterrents and/or other hazing techniques may be used to encourage target avian species to relocate from the 500-foot (152-meter) watch zone before the period when the Marine Traffic Safety Zone (MTSZ) will be cleared of personnel for safety reasons, before the implosion. After the MTSZ is cleared, long range auditory deterrents, such as sound cannons will be employed immediately prior to the blast, to discourage individuals from occupying the watch zone. Propane-powered sound cannons emit a short, loud shot and can cover areas up to 5 acres. A short series of bursts immediately prior to the implosion will ensure protected diving birds are cleared of the watch zone and will not enter the water at the moment of implosion.

Visual deterrents, such as long range lasers, may also be employed to discourage birds from entering the watch zone. Lasers systems use a red or green light and are effective to up to 1 kilometer. When the laser is pointed on the surface of the structure, or the blast mat covering Pier E3, birds will perceive the light as a threat and avoid the area. Direct exposure to the laser will be avoided.

4.3.3. Monitoring Plan

At least two monitors will be present to observe the watch zone around Pier E3 for bird activity. One monitor will be positioned on a boat near the pier, while the other monitor(s) may be stationed on the new SFOBB bicycle path, piers, and/or YBI. One monitor will be designated as the lead avian monitor and will communicate directly with the Lead Biological Monitor. Avian monitors will observe and record all bird activity within and surrounding the watch zone. At a minimum, the following data will be recorded:

- time;
- species;
- distance from Pier E3;
- cardinal direction relative to Pier E3; and
- behavior/status (i.e., flying through, foraging from the air, on water, diving, foraging below surface)

If a protected (e.g., FESA, CESA, or CFGC-fully protected) bird(s) is sighted, the monitor(s) will observe its activity. If the bird(s) is in the air and traveling from the watch

zone, no further action will be necessary. If the bird(s) is sighted diving into or foraging in the water column within the 500-foot watch zone, the monitor will communicate this information to the lead avian monitor, who will relay the information to the Lead Biological Monitor and the info will be communicated to the Department Resident Engineer. The implosion of Pier E3 will be delayed until the protected species is no longer submerged in the water column within the watch zone. Departure of an individual bird from the watch zone will be documented immediately and will be communicated to the Lead Biological Monitor.

If an injured or dead bird is sighted after the demolition blast event, the lead avian monitor will notify the Lead Biological Monitor who will contact USFWS and CDFW within 24 hours. Rescued or salvaged individuals will be transferred to a wildlife care facility for rehabilitation and will be released or euthanized if required. The Department will make arrangements with a local wildlife care center before the Pier E3 implosion. USFWS and CDFW will have the authority to perform a necropsy on any captured bird to determine whether the implosion was cause of the injury or death. Individuals that may be mortally affected by implosion will be collected and donated to the University of California, Berkeley Museum of Vertebrate Zoology. Such situations are expected to be dealt with on a case-by-case basis. In addition to the protocol above, the following steps will be followed during the implosion:

- The AMP will be finalized in coordination with the licensed blaster, the observation team, USFWS, CDFW, and the Department.

- At a minimum, the watch crew will consist of a lead avian monitor, one bridge-based or fixed observer, and one boat-based avian monitor. The lead avian monitor may be one of the previously mentioned observers. All observers will have had previous experience in observing/spotting diving birds.

- Avian monitoring will begin at least 1 hour before the scheduled start of the implosion to identify the possible presence of diving birds. Prior experience with the use of bubble curtains for pile-driving activities for the SFOBB Project suggests that birds will not be attracted to the BAS system. However, initial activation of the BAS may stir up sediments or other small prey items that can act as a short-term source of food for foraging birds. Monitoring during this period before the implosion will allow observers to evaluate the potential risk to protected species. Avian monitoring will continue for at least 30 minutes after the implosion.

- Observers will follow the protocol established for the AMP and will conduct the watch in good faith and to the best of their abilities.

- After the MTSZ has been cleared for safety before the implosion, any bird in the area will be deterred from the 500-foot watch zone using techniques such as hand-held lasers and/or propane cannons.

- The implosion will be weather-dependent. Climatic conditions must be suitable for viewing of avian species. The implosion will be delayed if weather conditions result in unsafe boat observations, during periods of fog, wind, or heavy rain. The lead avian monitor with direction from the Biological Monitor will determine whether observation conditions are suitable before the start of the survey for the implosion.

- Implosion will be limited to daylight hours for safety reasons and to allow for adequate observation of the SFOBB Project area for diving birds.

4.4. Reporting

Within 30 days of the Pier E3 implosion, the Department will submit a summary report to CDFW and USFWS. This report will include the observer logs, in addition to the names of the observers, their positions during the implosion, the number and location of birds sighted, and actions taken when the animals were observed. The report also will note any dead or injured fish observed and/or collected. The report will reference the appropriate permit or other authorization numbers. Any issues associated with the Demonstration Project, potential project impacts on protected avian species and fish species, and suggestions for improving the AMP will be documented in the report.

The Department has been partnering with local environmental organizations, to listen and respond to concerns regarding the Pier E3 implosion. As part of this partnering, the Department will provide a summary of the avian monitoring efforts to these groups after the implosion, if requested.

Chapter 5. Pacific Herring Monitoring Plan

As a CDFW-managed fishery and Magnuson-Stevens Act managed species, the Department proposes to use scanning equipment to complete a search of the area around Pier E3 if post-implosion work (i.e., clam-shelling, post-implosion debris collection) occurs during the Pacific herring spawning season between December 1 and February 28. Only post-implosion work potentially can occur during this period, because the implosion cannot occur after November 30. the Department also will submit a Pacific Herring Work Waiver request to CDFW for any work completed during this period. A large school of Pacific herring is defined as a contiguous mass that records for a minimum of 30 seconds on fathometer at 3 knots.

5.1. Monitoring Plan

CDFW requires that the Department monitor within 1,640 feet (500 meters) of any activity that may affect schools of herring or spawning herring during the herring spawning season. If work associated with the Pier E3 Demonstration Project occurs during the herring spawning season, the Department's herring surveys will include a single pass of the entire area within 1,640 feet (500 meters) of Pier E3, with the fathometer turned on and the boat traveling no faster than 3 knots. If a large school of fish is detected on the fathometer (see above for definition of large school), the observer will note the location of the school using GPS and will document the date and time; the Department will stop work and will notify CDFW. Work will not resume until the school of fish clears the work area and/or CDFW confirms the school of fish is not Pacific herring. If a Pacific herring spawning event occurs within 1,640 feet (500 meters) of the debris removal work area, the work will not resume until it is confirmed that Pacific herring and associated roe are no longer within 1,640 feet (500 meters) of the work area.

5.2. Reporting

If debris-removal work occurs during the herring spawning season, daily monitoring reports will be provided by the Department to appropriate staff at CDFW by close of business the day following monitoring. Daily Pacific Herring monitoring reports will include the following:

- The number and types of project activities;
- A description of any large masses of fish congregating in the area around the Pier E3 debris-removal work area, including location information; and

- A description of the species captured and identified (if required).

If Pacific herring monitoring is conducted, monitors will prepare a final monitoring report after the Demonstration Project is completed. This report will be provided to CDFW. The final monitoring report will include the following:

- A list of project activities conducted during the period, including dates and times;
- A summary of monitoring activities conducted during the period; and
- A summary of fish congregations observed during the monitoring, and descriptions of the species confirmed to be involved through the capture techniques used.

Chapter 6. Hydroacoustic Monitoring Plan

The purpose of hydroacoustic monitoring during the controlled implosion of Pier E3 is twofold: 1) to evaluate distances to specific fish and marine mammal impact noise criteria; and 2) to improve the prediction of underwater noise for assessing the impact of the demolition of the remaining piers through future controlled implosions.

6.1. Noise Criteria

Noise criteria for marine mammals for the Pier E3 implosion will follow the interim underwater explosive criteria established by NMFS, as shown in Table 1. For fish, the agreed on criteria are those currently established by the Fisheries Hydroacoustic Working Group for underwater impact pile driving along the West Coast. These criteria, for the onset of injury, include a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2/second for fishes more than 2 grams and 183 dB re 1 μPa^2/second for fishes less than 2 grams, and a single-strike peak level (L_{peak}) of 206 dB re 1 µPa for all sizes of fishes (Stadler and Woodbury 2009).

6.2. Effects of Implosion on Sound Parameters

The controlled implosion will consist of 588 individual blasts of charge weights ranging from 21 to 35 pound/delay. The controlled implosion event will have a 4 to 6-second duration, from the first detonation to the last, with individual charges separated by 9 milliseconds. Close to the pier, the individual blasts will be identifiable, and for any one measurement location, the highest peak pressure can occur at any time during the 4 to 6-second duration. During the event, the pier will be encircled with a BAS, which will produce a bubble curtain around the structure to attenuate noise and pressure generated by the controlled implosion (Figure 5). Blast mats will be positioned on top of the structure, to control flying rock.

The proposed sequence for the implosion of Pier E3 is complex. The controlled blast sequence will start in an interior wall's bore hole near the southern portion of the structure, followed by successive adjacent walls throughout the pier, as shown in Figure 6. Blasts in the inner walls will occur just before the adjacent outer walls, with the interior to exterior blast sequence continuing across the structure, moving from south to north and from lower deck to upper deck in the sequence. As the implosion progresses, locations east, north, and west of the pier will be shielded from the blasting on the interior of the structure, with the still-standing exterior walls of the pier. Towards the conclusion

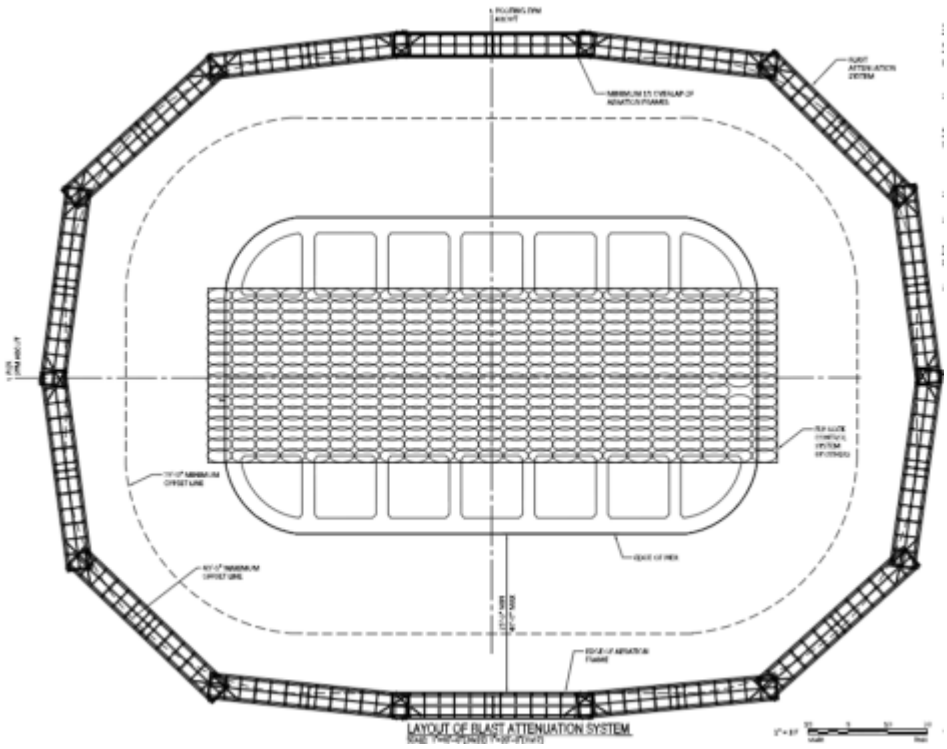


Figure 5. Blast Attenuation System

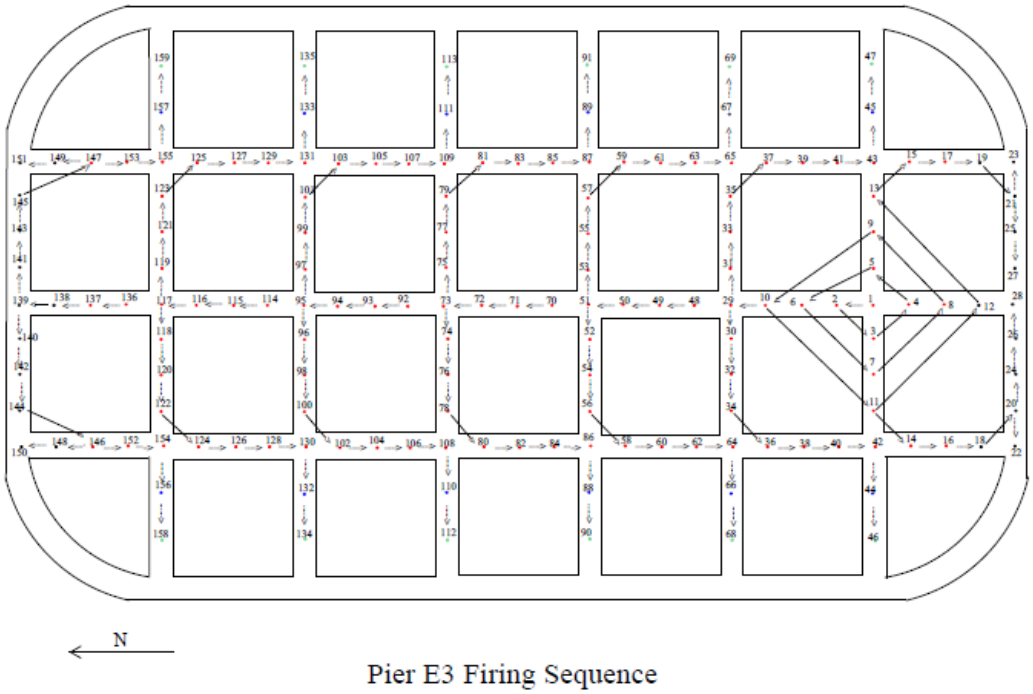


Figure 6. Pier E3 Firing Sequence

of the implosion, however, the water column in each direction will experience unshielded blasts from the outer walls. Below the mud line, the perimeter walls of the pier's caisson will remain intact with only removal of the interior walls to approximately -77 feet (NGVD29).

Because of the proposed implosion sequence, the peak pressure in any one direction from the pier is expected to be similar, although occurring at different times. For the SEL values, levels to the south of the pier may be somewhat higher because fewer of the total delays will be shielded by the structure due to the earlier collapse of the southern exterior walls. Delays below the mud line may have further sound attenuation, resulting from the shielding presence of the intact exterior pier walls. Expected underwater noise levels for peak pressure and SEL have been calculated and are shown in Figure 6, along with the fish criteria for peak pressure and SEL. The distances to the fish criteria are shown in Table 5, and those for marine mammals are shown in Table 1. The peak pressure levels shown in Figure 7 were used to consider the instrumentation required in this Hydroacoustic Monitoring Plan.

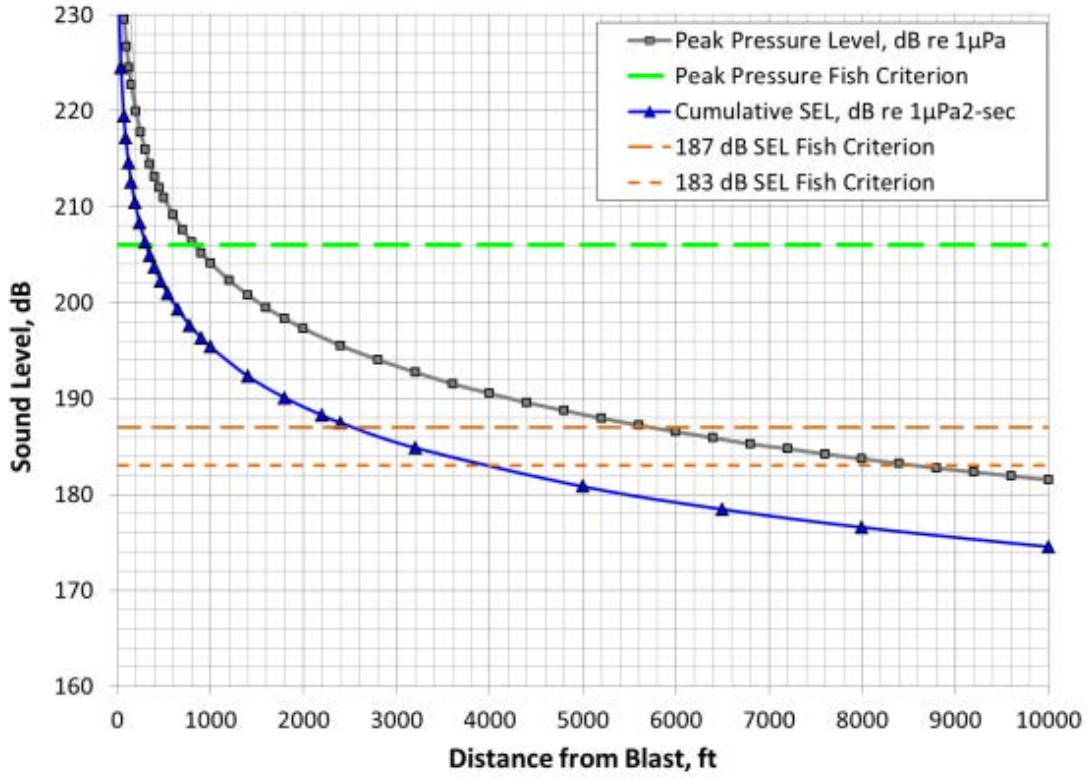


Figure 7. Calculated Peak Pressure Level and Cumulative SEL versus Distance with Fish Criteria

Table 5. Calculated Distances to Fish Criteria		
Criteria		Distance to Criteria Limit, feet
Description	Level, dB	
Peak Pressure	206	820
Total Cumulative SEL, ≥ 2 gram	187	2,550
Total Cumulative SEL, < 2 gram	183	4,000
Source: Illingworth & Rodkin		

6.3. Monitoring Methods

Monitoring of the implosion is specific to two regions around Pier E3 with unique methods, approaches, and plans for each of these regions. These regions include the "near field" and the "far field." For Pier E3, the near field will include measurements taken within 500 feet of the pier, while the far field will include measurements taken at 500 feet and all greater distances. Several reasons exist for this distinction. Within 500 feet, the peak pressures are expected to be sufficiently high so that pressure transducers will be required for data acquisition instead of conventional hydrophones. In addition, in the near field, the dimensions of the pier are relatively large compared to the measurement distance. Therefore, the relationship between sound pressure and distance from the pier likely will be complex because the pressure from any one blast will depend not only on distance from the pier, but also on the position of the blast along the face of the pier. Beyond 500 feet, sound levels are expected to display a more consistent logarithmic fall-off with distance. Furthermore, the blaster in charge will limit personnel and materials within 1,500 feet of the implosion.

6.4. Equipment Description and Calibration

Inside the BAS, the rise time of the pressure signals will be very short and will require high speed acquisition of data. Sampling rates inside the BAS at a minimum of 1 megahertz (MHz) (one record per 0.001 milliseconds) are required to be certain to capture the true peak pressure. After it has gone through the BAS, the pressure signal will spread out in time and will lower the high frequency content of the signals. High frequency content also will be attenuated more rapidly than low frequency content as a function of distance from the implosion.

Because of the rapid rise time of pressure signals within 500 feet of the pier, two types of pressure transducers will be used for the near-field monitoring. Inside of the BAS, where pressures are expected to be highest, a specialized high pressure transducer capable of measuring up to 5,000 pound per square inch (psi) will be used. Outside the BAS, where

pressures will be reduced, standard pressure transducers capable of measuring up to 1,000 psi will be used. No method of field calibration exists for the pressure transducers. However, within 6 months of the scheduled controlled implosion, the pressure transducers will be laboratory calibrated by a service traceable to the National Institute of Standards and Technology (NIST).

For far-field measurements greater than 500 feet from Pier E3, high-speed sampling rates as required inside the BAS are assumed to be not as critical for characterizing and quantifying the sound signals from the implosion. This assumption will be verified at the 500-foot measurement distance, where both high-speed (i.e., standard pressure transducers) and more conventional speed instruments (i.e., hydrophones) will be compared. These data will be used to relate the two instrument systems and provide a conventional speed baseline at 500 feet for comparing to the more distant locations when establishing a sound pressure fall-off rate.

At the time of deployment, each hydrophone system will be field calibrated using a pistonphone calibrator, generating a 250 Hz tone at a known level for the type of hydrophone and calibration coupler. Within six months of the scheduled demolition blasting, the hydrophone (similar to the pressure transducer) will be laboratory calibrated by a service traceable to the NIST.

6.5. Near-Field Monitoring Plan

6.5.1. Monitoring Locations

Locations for monitoring equipment under the Near-Field Monitoring Plan are shown in Figure 8 and include 13 monitoring locations.

Directly south of Pier E3, a single measurement line will extend outward to 500 feet from the pier. This line will run in alignment with monitoring equipment to be used for the far-field monitoring (Section 7.6.2). Along this line, two high-pressure transducers, one located at 20 feet below the surface and a second placed 2 feet above mudline (approximately 51 feet NGVD) will be located inside of the BAS at approximately 25 feet from the pier. Outside the BAS, additional stations containing two standard pressure transducers placed at 20 feet below the surface and 2 feet above mudline will be located 100 and 150 feet from the pier, respectively. At 250 and 350 feet from the pier, two stations containing a single, standard pressure transducer, placed 20 feet below the surface, will be positioned (red circles on Figure 8).

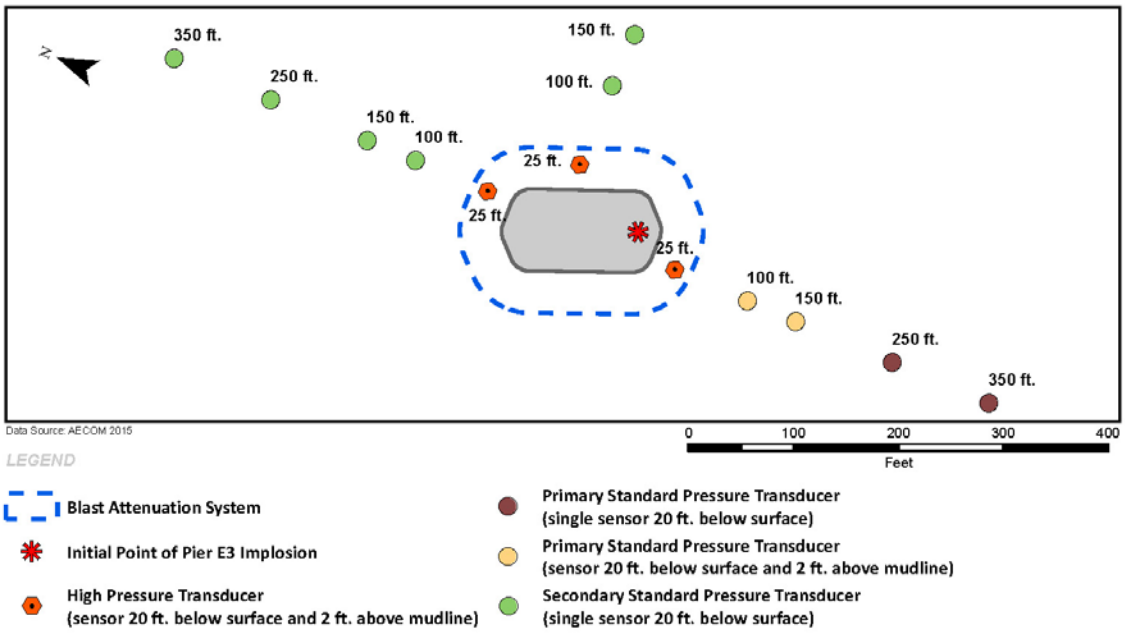


Figure 8. Locations for Near-Field Monitoring

In addition to this primary monitoring line, secondary monitoring arrays will be run north and east of the pier (green circles on Figure 8). Along each of these arrays, one high pressure transducer will be placed inside the BAS at 20 feet below the surface. To the east, two more standard pressure transducers will be placed, 20 feet below the surface, at 100 and 150 feet from the pier on line perpendicular to the wide face of the pier, respectively. Standard pressure transducers will be placed to the north, 20 feet below the surface, at 100, 150, 250, and 350 feet from the pier. These northern locations mirror those to the south and are positioned to monitor the implosion toward the end of the blasting sequence in which more shielding is expected by the structure.

6.5.2. Data Recording and Storage for Near-Field Monitoring Equipment

A transient data recorder, capable of recording and storing data from each pressure sensor at these sampling rates or greater, will be employed. The equipment requirements are summarized in Table 6.

Table 6. Requirements for the Near-Field Monitoring Equipment					
Location	**Sensor**	**Maximum Pressure**	**Transducer Frequency Range**	**Signal Conditioner Frequency Range**	**Data Acquisition/ Storage Rate**
Inside BAS	High Amplitude Pressure Transducer	5,000 psi	2.5 to 1000 kHz	1 to 1000 kHz	≥1000 kHz
Outside BAS	Pressure Transducer	1,000 psi	1 to 170 kHz	1 to 1000 kHz	≥1000 kHz
Source: CDB					

6.5.3. Pressure Exposure and Sensitivity for Near-Field Monitoring Equipment

Determining the near-field maximum pressure and pressure sensitivity also will be important in monitoring the implosion. Estimation of these features for Pier E3 is complicated by uncertainty in values expected to be encountered at each measurement distance inside and outside the BAS. During the implosion, some of the energy released by the controlled charges will be absorbed to fracture the concrete and will not be released into the water column. Confinement is a concept in blasting that predicts the amount of blast energy that is expected to be absorbed by the surrounding structural material, resulting in the fracturing necessary for demolition. The energy beyond that absorbed by the material is the energy that produces the pressure wave propagating away from the source. The Department determined that modeling with confinement was appropriate for the Pier E3 implosion, evaluating case study data for underwater implosions similar to the SFOBB Pier E3 implosion. The Department compared case study results to published blast models that incorporate a degree of confinement.

For estimating the sound pressures to calculate the distance to the various fish and marine mammal criteria during the implosion, a conservative confinement value of K=7500 was applied because of the individual charges being placed within holes embedded in the 3-foot-thick pier walls. This is equivalent to a 65 percent reduction in the peak pressure. In addition, the BAS is conservatively expected to reduce the pressure by 80 percent. Combined, these are expected to result in a 93 percent or 23 dB in peak pressure level reduction when compared to an open water blast with no BAS. Alternatively, the charges during the implosion can be better confined, and the BAS can perform better than under the conservative assumptions, and can approach a reduction in peak pressure level of almost 42 dB.

As a result of this uncertainty, optimizing the measurement level range of the monitoring systems at each distance inside and outside the BAS is important to account for the

maximum range of potential pressure levels. In Table 7, the calculated pressures in psi and pressure level in dB re 1μPa for each distance are shown. Inside the BAS, the scenarios are for an open water blast (0 percent BAS, K=21,600) and for an expected confinement of 65 percent (0 percent BAS, K=7,500). Outside the BAS, the scenarios are an open water blast (0 percent BAS, K=21,600) and under the expected scenario of 65 percent confinement and 80 percent attenuation by the BAS (80 percent BAS, K=7,500). Output voltages corresponding to these pressures for two candidate transducers also are shown. To be compatible with other instruments in the measurement chain, output voltages of the transducers will be limited to a maximum of 5 to 8 volts. Use of a PCB 138A05 model transducer inside the BAS and a PCB 138A01 model transducer are expected to meet these requirements.

Table 7. Estimated Peak Pressures and Transducer Types for Each Near-Field Hydroacoustic Monitoring Distance

Distance to Measurement	Prediction Assumptions	Range of Peak Pressure		Transducer Type	
				PCB 138A01	PCB 138A05
		psi	dB	Voltage	Voltage
25 ft	0% BAS, K=21,600	2167	263.5	10.834	2.167
	0% BAS, K=7,500	752.3	254.3	3.761	0.752
100 ft	0% BAS, K=21,600	452	249.9	2.262	0.452
	80% BAS, K=7,500	31.4	226.7	0.157	0.031
150 ft	0% BAS, K=21,600	286	245.9	1.430	0.286
	80% BAS, K=7,500	19.9	222.7	0.099	0.020
250 ft	0% BAS, K=21,600	161	240.9	0.803	0.161
	80% BAS, K=7,500	11.2	217.7	0.056	0.011
350 ft	0% BAS, K=21,600	109.8	237.6	0.549	0.110
	80% BAS, K=7,500	7.6	214.4	0.038	0.008

Source: CDB

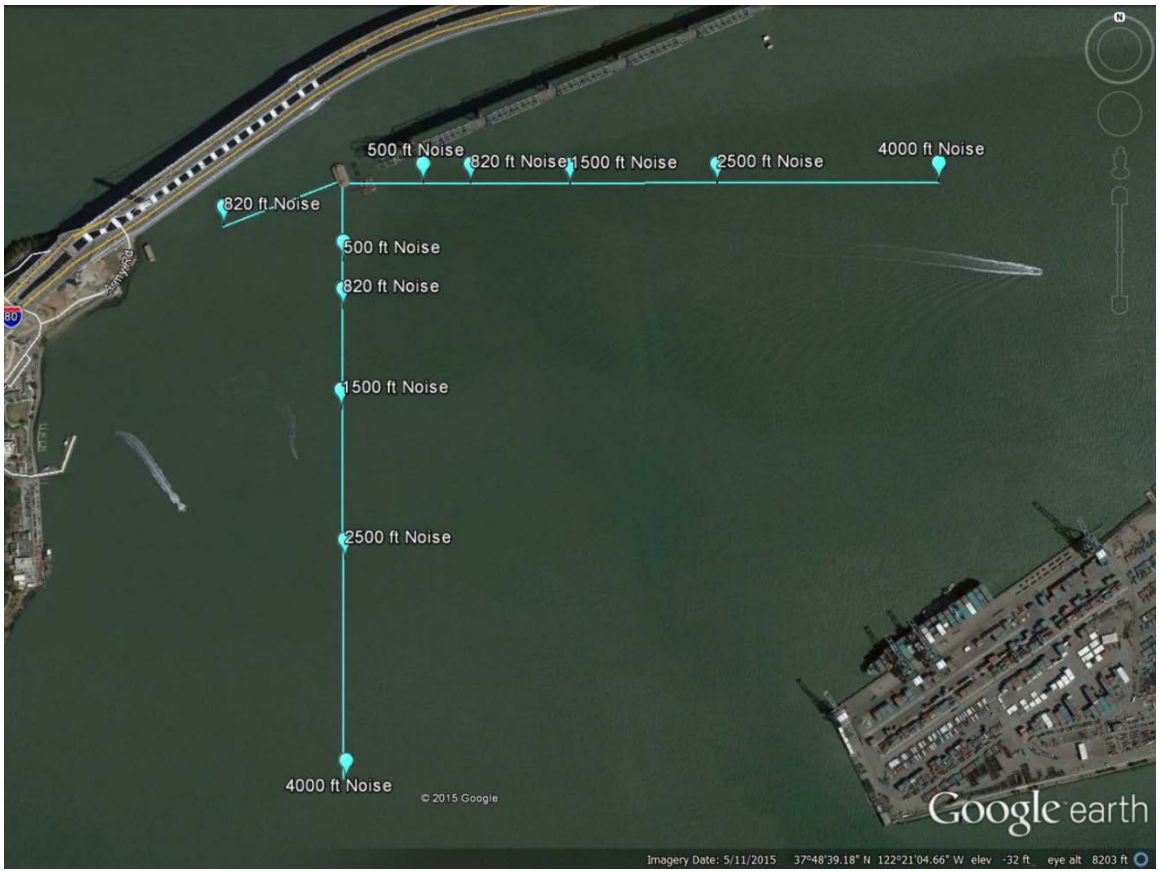
6.6. Far-Field Monitoring Plan

6.6.1. Monitoring Locations

The 11 locations for monitoring equipment under the Far-Field Monitoring Plan are shown in Figure 9. Directly east and directly south of Pier E3, two measurement lines will extend outward from the pier to a maximum distance of 4,000 feet. The distances of 500, 820, 1,500, 2,500, and 4,000 feet were selected to coincide with estimated fish criteria distances, and to follow a logarithmic progression of level with distance. The 206 dB peak level criterion is estimated to be at 820 feet, while the SEL criterion of 187 dB and 183 dB are estimated to occur at about 2,500 feet and 4,000 feet, respectively. The fall-off rate for peak pressure level is expected to be 6.8 dB per doubling of distance, and

the SEL is 6.3 dB per doubling of distance. For the distances of 500, 820, 1,500, 2,500, and 4,000 feet, difference in SEL level between measurement points ranges from 4.6 to 5.9 dB, which is less than the estimated rate of 6.3 dB per doubling of distance. Therefore, the fall-off rate will be well defined by the selected measurement distances. Accurately determining these fall-off rates will be critical for future predictions of noise effects during additional pier demolitions. The measurement line to the south was selected to align with the near-field monitoring line so that the propagation rate from 100 to 4,000 feet can be determined accurately. The southern line will avoid obstructions from the old and new bridge spans, will provide propagation data for relatively deeper waters around the pier, and will record the highest SEL values because of nature of the blasting plan. The measurement line to the east was selected because the water becomes gradually shallower in this direction. Because the demolition of subsequent SFOBB piers to the east will be done in shallower water, it is important to determine whether the propagation rate here will differ from the deeper water. This direction also is off of a corner of the pier so that it will capture data from both the short and longer faces of the pier. The pressure transducers and hydrophones will be suspended to a depth of 20 feet or at mid-depth for shallower locations.

West of Pier E3, measurements will be made at one additional location perpendicular to the west face of the pier. A hydrophone will be positioned 820 feet from the pier. The hydrophone will be located at a depth of 20 feet. Measurements in this direction were included because this location more uniformly will receive pressure from blasts across the longer face of the pier. This also is in the direction of YBI, where marine mammal activity may be greater.



Source: Illingworth & Rodkin

Figure 9. Locations of Far-Field Hydroacoustic Monitoring Stations

6.6.2. Far-Field Monitoring Equipment

As previously mentioned, within 500 feet of Pier E3, the high speed pressure transducer and recording system will be capable of sampling at a rate of 1 MHz or greater and storing data at the same rate at least. At 820 feet, 1,500 feet, 2,500 feet, and 4,000 feet, the conventional hydrophone systems will be capable of sampling and storing data at a minimum of 96,000 Hz. These locations will be unattended during the implosion and will acquire data continuously after initial deployment through post-implosion retrieval. Table 8 summarizes the sampling speed and frequency response requirements at the far-field monitoring distances.

As discussed in the Near-Field Monitoring Plan, maximum pressure and pressure sensitivity also are important for monitoring the implosion. In Table 8, the calculated pressures in psi and pressure level in dB re 1µPa for each distance is shown under the scenario of an open water blast (0 percent BAS, K=21,600), and under the expected scenario of 65 percent confinement and 80 percent attenuation by the BAS (80 percent BAS, K=7,500). Output voltages corresponding to these pressures for three candidate

Table 8. Estimated Peak Pressures and Transducer Types for Each Far-Field Hydroacoustic Monitoring Distance

Distance to Measurement	Prediction Assumptions	Range of Peak Pressure		Transducer Type	
				PCB 138A01	PCB 138A05
		psi	dB	Voltage	Voltage
500 ft	0% BAS, K=21,600	74	234.1	14.289	35.89
	80% BAS, K=7,500	5.1	210.9	0.990	2.49
820 ft	0% BAS, K=21,600	42	229.2	8.154	20.48
	80% BAS, K=7,500	2.9	206.1	0.569	1.43
1,500 ft	0% BAS, K=21,600	21	223.3	4.121	10.35
	80% BAS, K=7,500	1.5	200.1	0.285	0.72
2,500 ft	0% BAS, K=21,600	12	218.3	2.314	5.81
	80% BAS, K=7,500	0.8	195.1	0.161	0.40
4,000 ft	0% BAS, K=21,600	7	213.7	1.360	3.42
	80% BAS, K=7,500	0.5	190.5	0.094	0.24

Source: Illingworth & Rodkin

transducers also are shown. To be compatible with the transducer's power supply, output voltages of the transducers will be limited to a maximum of 5 to 8 volts, and this limit will be applied throughout the entire measurement system. Based on these considerations, the systems deployed at the different distances will be tailored to meet the required frequency ranges and expected voltages. Requirements for the far-field monitoring

equipment are shown in Table 9, and equipment expected to be used is shown in Table 10.

Table 9. Requirements for the Far-Field Monitoring Equipment

Distance/Sensor	Transducer Frequency Range	Signal Conditioner Frequency Range	Data Acquisition/ Storage Rate	Frequency Analysis Range
500ft/Pressure Transducer	2.5 to 1000 kHz	1 to 1000kHz	≥1000kHz	2.5 to 500kHz
500ft/Hydrophone	1 to 170kHz	1 to 500kHz	≥500kHz	1 to 250kHz
820ft/Hydrophone	1 to 140 kHz	1 to 100kHz	≥96kHz	1 to 44kHz
1500ft/Hydrophone	1 to 140 kHz	1 to 100kHz	≥96kHz	1 to 44kHz
2500ft/Hydrophone	1 to 140 kHz	1 to 100kHz	≥96kHz	1 to 44kHz
4000ft/Hydrophone	1 to 140 kHz	1 to 100kHz	≥96kHz	1 to 44kHz
Source: Illingworth & Rodkin				

Table 10. Equipment Expected to be Used in the Far-Field Hydroacoustic Monitoring Plan

Distance/Sensor	Transducer	Transducer Power Supply	Data Acquisition/ Storage Rate	Sampling Rate, Sample/sec
500 ft/Pressure Transducer	PCB 138A01	PCB 482A21	Astro-Med Dash 8HF-HS	2 GHz
500 ft/Hydrophone	Reson TC4013	PCB 480C02	Astro-Med Dash 8HF-HS	2 GHz
500 ft/Hydrophone	Reson TC4013	PCB 480C02	Roland R-05 Recorder	96 kHz
820 ft/Hydrophone	Reson TC4013	PCB 480C02	Roland R-05 Recorder	96 kHz
1500 ft/Hydrophone	Reson TC4013	PCB 480E09	Roland R-05 Recorder	96 kHz
2500 ft/Hydrophone	Reson TC4013	PCB 480E09	Roland R-05 Recorder	96 kHz
4000 ft/Hydrophone	Reson TC4013	PCB 480E09	Roland R-05 Recorder	96 kHz
Source: Illingworth & Rodkin				

6.6.3. Far-Field Monitoring Methods

6.6.3.1. TRANSITION BETWEEN NEAR-FIELD AND FAR-FIELD LOCATIONS

At the two 500-foot monitoring locations, measurements will be made using unmanned rafts anchored at each site. At the three 820-foot locations, measurements also will be made using unmanned rafts or autonomous recording systems, suspended at a depth of 20 feet. At the 2,500-foot and 4,000-foot locations, the measurements will be made using unmanned rafts anchored at the site. At 1,500 feet, the two boats will each deploy a hydrophone guided down the anchor line to a depth of 20 feet and attached to the boat. The two boats will be manned by two hydroacoustics monitors each. One of the two monitors per boat will be a senior hydroacoustics expert with a minimum of a Bachelor of Science or related degree and more than 5 years of experience in the measurement of transient underwater sounds, who will oversee the data acquisition. The second will be an

assistant with a minimum of 2 years of experience in the underwater sound measurement, who will support the hydroacoustics expert in the deployment and calibration of the systems.

6.6.3.2. OTHER FAR-FIELD LOCATIONS

At the other far-field locations, the implosion will be recorded using unmanned stations consisting of a raft containing a solid-state data recorder, transducer power supply, and a hydrophone. These stations will be located and deployed 2 hours in advance of the scheduled time for the implosion. At each of the unmanned stations, an anchor will be placed and buoy will be attached to the anchor line. The raft will be secured to the anchor line. A weighted line will be suspended from the raft to a depth greater than the hydrophone line. A separate hydrophone line will be guided down the weighted line to a depth of 20 feet or mid-depth. The hydrophone line will be loosely attached to the raft. This deployment method will reduce any strumming sounds. Because the measurements are to occur at slack tide, no additional measures will be taken regarding cable strumming. These deployments will follow the guidance of ISO Committee Draft ISO/TG 43/SC3, Underwater Acoustics—Measurement of Radiated Noise from Percussive Pile Driving. Hydroacoustic personnel from the previously described 500-foot locations will be responsible for deploying these stations. All measurement positions will be established by GPS to within 7 feet (2 meters).

6.7. Signal Processing and Analysis

To compare with appropriate marine mammal and fish sound criteria, the implosion's pressure signals will need to be reduced and analyzed to obtain peak pressure level, impulse, cumulative SEL, and RMS levels. To reduce the data from the far-field measurement locations beyond 500 feet, the recordings will be scanned to isolate the implosion. The implosion then will be captured by the same data acquisition device(s) used to monitor and capture the pressure signals at the 500-foot locations. The pressure versus time signals from the near- and far-field monitoring locations then will be processed using the same algorithm to calculate the required metrics. Peak pressure level is defined as:

$$L_{pk} = 20\ Log_{10}\left(P_{pk}/P_{ref}\right) \qquad (1)$$

where L_{pk} is the peak level in dB and P_{ref} is the reference pressure of 1µPa. The acoustic impulse that is the time integral of the under positive peak pressure is given as:

$$Im = \int_{t_1}^{t_2} P(t)\ dt \quad (2)$$

where $P(t)$ is the instantaneous pressure, t_1 is the time of the first zero cross of the positive pressure corresponding to L_{pk} and t_2 is second zero crossing of positive pressure. Cumulative SEL is given by:

$$SEL_{cum} = 10\ Log_{10}\left(\int_0^T \frac{P^2(t)\,dt}{P_{ref}^2}\right) \quad (3)$$

where T is the duration of entire implosion, $P^2(t)$ is the instantaneous pressure squared and T_{ref} is the reference time of 1 second. The RMS level is given by:

$$L_{RMS} = 10\ Log_{10}\left(\sqrt{\frac{1}{T_2-T_1}\int_{T_1}^{T_2} \frac{P^2(t)\,dt}{P_{ref}^2}}\right) \quad (4)$$

where T_1 is the time at the beginning of the event and T_2 is the time at the end. The peak pressure level is determined by identifying the maximum pressure in the signal and calculating the level as defined in Eqn. 1. The other quantities defined in Eqns. 2 through 4 will be calculated using the numerical equivalent of these equations. For each of the quantities determined with Eqns. 1 through 4, a fall-off rate of the metric with distance will be determined using the near- and far-field data. These rates will be used to estimate the distance to which the respective criteria are exceeded.

6.8. Reporting

All of the digital field records from the pressure transducers and hydrophones will be provided on the day of the implosion. Peak pressure level, impulse, cumulative SEL, and RMS sound pressure level will be reported for each of the near- and far-field hydroacoustic monitoring locations. Along the measurement lines extending to the east (shallower water) and south (deeper water) of the pier, the computed fall-off rate for each metric will be reported, along with the estimated distance to the respective fish and marine mammal criteria. The differences in the values measured inside and outside the BAS will be calculated, and the performance of the BAS as a function of distance will be reported for each monitoring location outside the BAS. The actual, as deployed, positions of the monitoring stations, water depth, sensor depth, and distance/orientation to the pier will be documented. Validated results of the measurements will be available within 2 weeks of the implosion, and a draft report will be provided to the Department within 4 weeks. Equipment calibration and test charge verification procedures will be provided in the report.

Chapter 7. Fish Mortality Monitoring Plan

7.1. Bird Predation Monitoring

Accurate determinations of the pre-implosion occurrences of fish species around Pier E3 and within potential impact areas are not feasible. Fish can move rapidly through specific areas, and sonar or other detection methods are too imprecise to provide accurate guidance on the abundance or types of fish species present. However, large assemblages of fish may be identifiable to understand whether schooling fish are active in the area. Before the implosion, a series of sonar surveys will be conducted in the areas around Pier E3, to gain a general understanding of whether large assemblages of fish are present.

Immediately after the implosion, the boat-based and land-based avian monitors as described in Chapter 4 will transition to monitoring for signs of birds actively feeding on the water's surface. A congregation of birds feeding on fish which appear *en masse* near the surface of the water can be assumed to be evidence of fish mortality and/or injury because of underwater pressure waves or changes to water quality parameters. Monitors will be prepared to attempt to identify the species and size of any affected fish, through observation with binoculars or by retrieval of any dead or moribund fish from the water. All collected dead or injured protected fish species will be preserved for future examination. Any green sturgeon or salmonids killed and collected by the Demonstration Project will be preserved and transferred to NMFS, and any longfin smelt will be transferred to the California Department of Fish and Wildlife (CDFW) within 30 days of collection.

If feeding is observed, 1-minute counts of bird strikes will be initiated. These counts will be repeated throughout the duration of the monitoring period. When feeding events are not observed, 1-minute counts will be conducted to provide recorded confirmation that feeding events did not occur. Birds, such as gulls, that appear to scavenge fish from the surface will be recorded during each strike on the surface. Diving birds that may be present, but which cannot be confirmed to scavenge on injured fish while diving, will be noted on the data sheet but will not be included in the count of bird strikes. In addition, general bird activity and behavior during project activities and throughout the day will be noted and recorded.

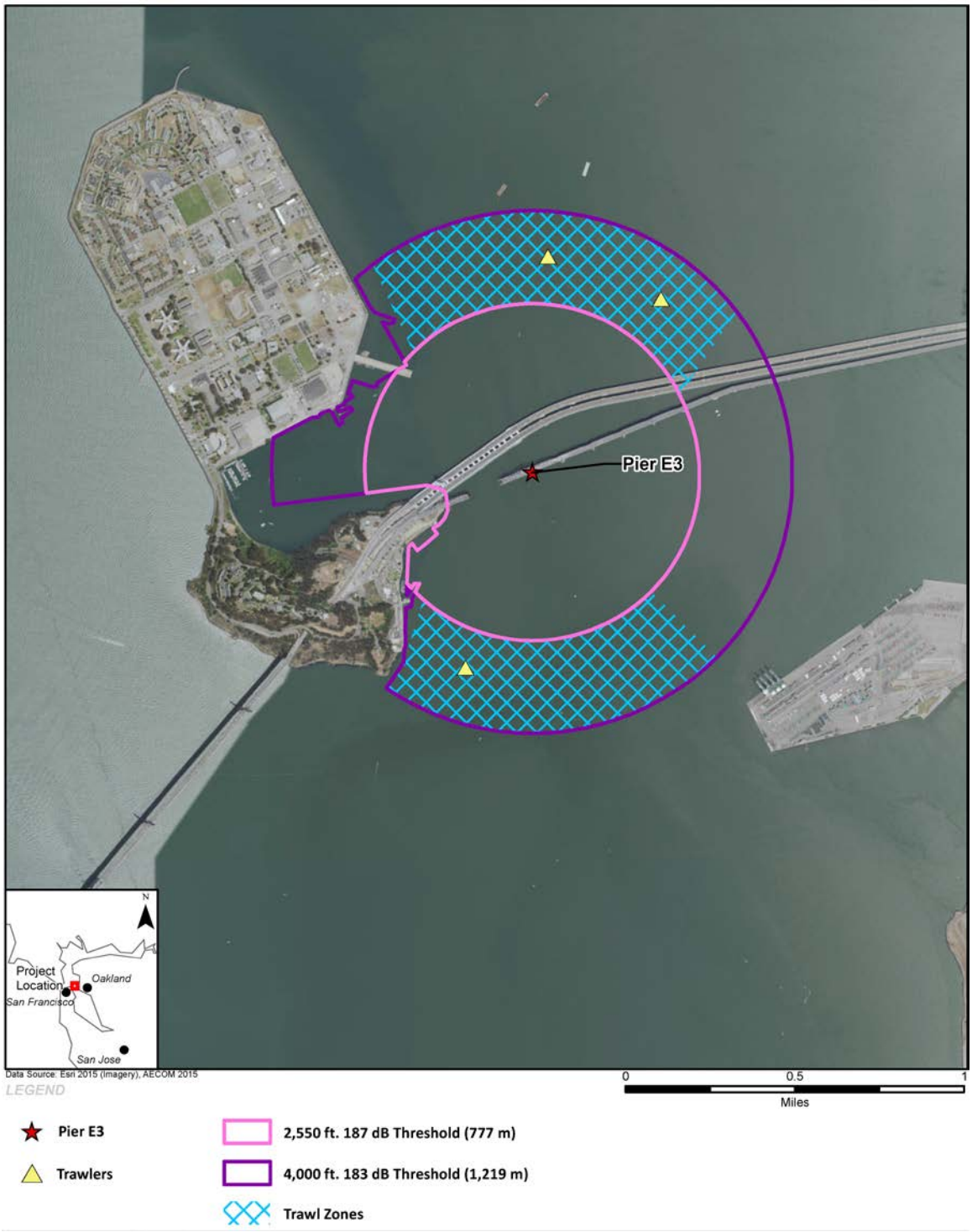
Reporting: Within 72 hours of the Pier E3 implosion, a summary report will be submitted to CDFW and the United States Fish and Wildlife Service (USFWS). The

report will note any dead or injured fish observed and/or collected and will summarize the results of the bird predation monitoring.

7.2. Trawling

To further collect data regarding the effects of the implosion on local fish populations, the Department will conduct a series of scientific trawls immediately following the blast. These trawls will occur for approximately 60 minutes following the implosion, when currents are static or slow-moving, and will be focused between 2,550 and 4,000 feet north and south of Pier E3. This zone corresponds to the cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2/second for fishes more than 2 grams (2,550-foot limit) and 183 dB re 1 μPa^2/second for fishes less than 2 grams (4,000-foot limit). The trawling will be conducted using both otter (bottom) and oblique (midwater) trawling nets focused within pre-defined trawling lanes (Figure 10). Fish collected during each pass will be sorted according to state (i.e., live, dead, or moribund). All live fish will be counted and then immediately will be returned to the water. Listed species (i.e., salmonids, longfin smelt, or green sturgeon) that are dead or moribund will be retained and stored in a preservative solution. Common species will be returned to the water, with the exception of 10 representative individuals per species per trawl. After the trawling is completed, only individual state-protected species that are retained will be necropsied to better assess any physiological damage sustained by the blast. A more detailed description of these trawling activities will be included in the Trawling Plan, which will be approved by CDFW before the implosion.

Reporting: The Department will prepare a report summarizing the results of the trawling exercise, including, species collected and necropsy results. The report will describe to the extent feasible the physiological effects of the implosion on necropsied fish.



Source: AECOM

Figure 10. Trawling Zones – Post Implosion

Chapter 8. Test Charge

Capturing the acoustic results of the implosion will be critical in determining whether this technique can be used for future removal of other in-water piers. A key factor in accurately capturing hydroacoustic information will be to ensure triggering of the data acquisition and recording instruments. The instruments will use high-speed recording devices during near-field and far-field monitoring of the implosion. To this end, the pressure-time signature of a blast cannot be duplicated except with another blast. Thus, release of a small test charge before the actual implosion will be required to validate that all equipment is functional and to set the triggering parameters accurately for the implosion. Use of this small charge will greatly increase the confidence in adequately capturing hydroacoustic information for the implosion. In addition, the test charge will be measured inside and outside the BAS, and will provide insight on the level of reduction produced by the system. This information will further aid in refining the estimated range of levels expected from the pier implosion.

8.1. Scheduling and Testing

The test charge is scheduled to occur on October 31, 2015, after the BAS is positioned into place and is functional. The BAS will be in operation during the test. The test will use a charge weight of 18 grain (0.0025 pound) or less. The charge will be placed along one of the longer faces of the pier and inside the BAS while it is operating. The charge will be positioned near the center of the longer face of Pier E3, to shield the areas on the opposite side as much as possible from sound. The charge will be placed approximately halfway between the face of Pier E3 and the BAS. The BAS may be located anywhere from 25 to 40 feet from the face of Pier E3. Hydroacoustic monitoring inside the BAS will be done at a distance of 20 to 30 feet from the blast. Outside the BAS, hydroacoustics monitoring will occur at a distance of 100 feet from the charge, as shown in Figure 11. A maximum charge weight of 18 grains (0.0025 pound), released in open water with no confinement, is predicted to produce a peak pressure of 78 psi or 235 dB at 20 feet. Assuming a minimal attenuation by the BAS of 80 percent, the peak pressure is predicted to be 2.9 psi or 206 dB at a distance of 88 feet from the face of the pier. At the 100-foot monitoring location, peak pressure is predicted to be 2.5 psi or 205 dB.

Acoustic measurements during the test blast will be made with the same transducers and instrumentation to be used for the near- and far-field monitoring of the actual implosion, and as shown in Figure 11. Measurements inside the BAS will be made with near- and far-field systems using PCB 138A01 transducers. At the 100-foot distance, the near-field

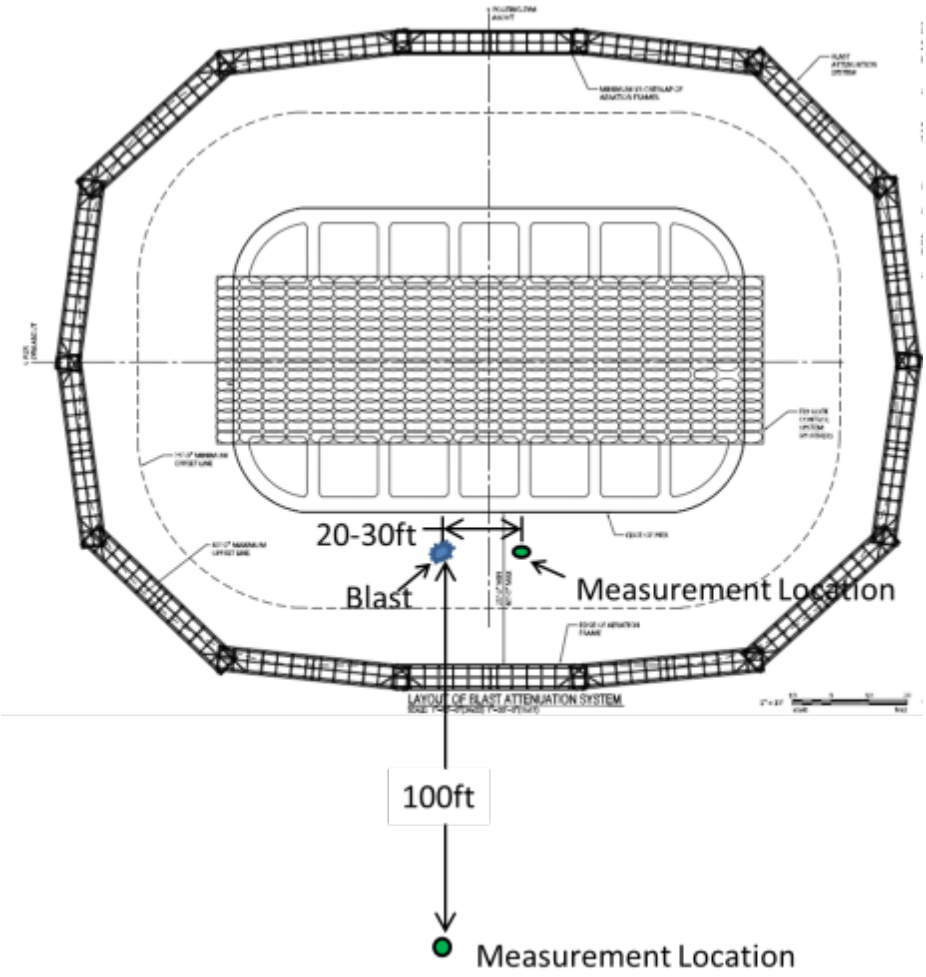


Figure 11. Test Charge Location and Hydroacoustic Monitoring Locations

system will use another PCB 138A01 transducer, while the far-field system will use both a PCB 138A01 transducer and a Reson TC4013 hydrophone. Before activating the BAS, ambient noise levels will be measured. While the BAS is operating and before the test, background noise measurements also will be made. After the test, the results will be evaluated to determine whether any final adjustments are needed in the measurement systems before the implosion. Pressure signals will be analyzed for peak pressure and SEL values before the scheduled time of the implosion.

8.2. Biological Effects of the Test Charge

Release of the test charge will occur in the water between the outside the pier's caisson walls and the bubble curtain produced by the BAS. The test charge may produce an underwater pressure wave, to be evaluated against the fish and marine mammal acoustic

thresholds previously presented. For the single-test charge, the estimated distance to 206 dB peak sound pressure level (the relevant fisheries threshold) is 88 feet. Using fisheries' data for November from CDFW's San Francisco Bay Study Project and methods previously described in the Demonstration Project's NMFS Biological Assessment Essential Fish Habitat Assessment (Department 2015), Table 11 lists the number of individuals by species that may be subject to harmful underwater pressure from the test charge. The regulatory status (i.e., state/federal listing) of these species also was described previously in the Demonstration Project's Biological Assessment. Impacts on federally listed salmonids or green sturgeon from the test charge are not expected, and impacts on the state-listed longfin smelt are estimated at less than one individual. This level of effect is not anticipated to have a long-term negative effect on the larger longfin smelt population. Similarly, the impacts on the other managed fish species identified in Table 9 from the test charge are not anticipated to have a long-term negative effect.

Table 11. Fish Species Potentially Affected by the E3 Test Charge

Species	# Individuals
Coho salmon	0.0
Chinook salmon	0.0
Steelhead	0.0
Green sturgeon	0.0
Longfin smelt	0.9
Northern anchovy	14.6
Pacific herring	1.3
Pacific sardine	0.0
English sole	43.3
Jacksmelt	1.9
Source: CDFW	

The distances to Level B Harassment—TTS or greater exposures for marine mammals during the release of the test charge were estimated and are shown in Table 12. All distances, with the exception of the high-frequency cetaceans (harbor porpoise), are extremely close to Pier E3 and within the deployment area of the BAS. Occurrence of marine mammals at these distances is not expected. For harbor porpoises, the distance to TTS was estimated at 270 feet. Using these distances and the marine mammal densities previously described, estimated exposure values for TTS were calculated. Exposures were calculated at 0.0005 harbor seals, 0.00008 California sea lions, and 0.00008 harbor porpoises. Harbor porpoises, however, are not expected to occur in the project area in November. Three marine mammal observers will be on-site during the test to confirm the absence of harbor porpoise before the release of the charge. As a result of this action plus

the small amount of potentially affected area subject to harmful sound, no impacts on marine mammals are anticipated from the test charge.

Table 12. Marine Mammal Exposure Distances for the E3 Test Charge

Species	Level B—TTS Threshold (dB peak SPL)	Estimated Distance from Charge (feet)
Pacific harbor seal	212	48
California sea lion	212	48
Northern elephant seal	212	48
Harbor porpoise	195	270

Source: NOAA 2015

Chapter 9. Caged Fish Study

During the Pier E3 implosion, the Department will deploy cages with fish near Pier E3 to assess potential impacts from controlled charges. This elective study is not a required monitoring program, but it is being carried out as an additional data collection effort to enhance the Department's knowledge of the Demonstration Project's potential impacts on fish species. Detailed information can be found in the Department's Pier E3 Marine Foundation Dismantling –Caged Fish Immediate Mortality and Injury Study Plan (Department 2015d). The Department proposes to deploy approximately 12 cages with 50 fish in each cage. The cages will be located along a transect line extending from the southern face of Pier E3 out 820 feet from the pier.

The caged fish study is designed to evaluate the effects of the implosion on juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and other salmonids and fish of similar morphology. Hatchery-raised juvenile Chinook salmon (late-fall run), sized from 4 to 6 inches, will be deployed with a density of 50 fish per cage. Each cage will be deployed along a pre-set buoy line that will hold the cage approximately 12 feet (approximately 4 meters) below the surface, within a water depth ranging from 30 to 50 feet. The caged fish transect will extend from a distance of 100 to 820 feet out from the Pier E3 face to coincide with the 206dB injury threshold to fish.

During the test blast that is scheduled before the Pier E3 implosion, the Department will deploy 12 cages in the same locations as proposed in the final caged fish study in a trial run, to test deployment and fish-handing methods. Three of those cages, including a control cage, a cage set at 100 feet and one set at 820 feet, will contain 50 fish each. The remaining nine cages will not contain fish during the test blast.

Cages, fish, and all associated equipment will be retrieved as soon as possible after the test blast and implosion.

Chapter 10. Water Quality Monitoring Plan

Information in this chapter related to water quality monitoring of the Pier E3 implosion originally was presented in the Procedures for Observations and Sampling San Francisco–Oakland Bay Bridge East Span Seismic Safety Project and the Water Quality Study for the Demonstration Project (Department 2014), but is presented again here with other biological monitoring plans to provide a complete picture of all monitoring plans associated with the Demonstration Project.

Several forms of over-water and in-water work are proposed for the Demonstration Project. These activities include mechanically dismantling the pier cap and pedestals to 9 feet above waterline, disposing the concrete rubble inside the caisson cells, in-water drilling operations into the inclined buttress walls, and retrieving and disposing debris with a clamshell bucket on a barge-mounted derrick crane. In addition, the contractor also prepared a Storm Water Pollution Prevention Plan (SWPPP) Amendment (SWPPP Amendment #4) for the Demonstration Project that was accepted by the Regional Water Quality Control Board (RWQCB) on July 21, 2015. On this basis, water quality monitoring for these over-water and in-water operations with potential to impact the Bay water will follow specifications provided in the Waste Discharge Requirements (WDRs) RWQCB Board Order No. R2-2002-0011, issued January 2002, and a contractor-prepared SWPPP, as well as those listed below.

The Department has made several observations of water quality monitoring for the SFOBB Project's current demolition activities that will improve the quality, representativeness, and presentation of data collected for the Demonstration Project. See below for additional specifications to be incorporated in the Water Quality Monitoring Plan.

- Monitoring locations north and south of Pier E3 will be selected, based on the vectors associated with the ebb and flood currents in the Demonstration Project area.

- Background water quality data will be collected concurrently with construction-related water quality data, to provide a representative baseline sample for comparison, rather than once before the start of each work day.

- Equal distribution of samples during high tide, low tide, and slack tide conditions will help in data interpretation, including background water quality samples.

- Water quality data will be presented against tidal stage, to assist in interpreting and presenting data; this can include a table that presents the times of maximum and minimum tidal stages for each day monitoring is performed, and a figure showing tidal stages and at which point samples were collected, or similar.

10.1. Mechanical Dismantling Monitoring Plan

Under the WDRs for the SFOBB Project (Order No. R2-2002-0011), the Department is required to prevent increases of turbidity and chemicals of concern in amounts greater than those specified by the RWQCB in the WDRs (Table 13). To address the turbidity specification, construction will take place in accordance with an approved Turbidity Control Plan. In addition, the Department will conduct monitoring and reporting activities according to a Self-Monitoring Program (SMP), included as an attachment in the WDRs. The purpose of the SMP is to document compliance with effluent requirements and prohibitions established for the SFOBB Project, and to facilitate self-policing by the Department for the prevention and abatement of pollution arising from dredging and fill activities. This plan outlines turbidity control measures intended to protect eelgrass beds and other biological resources during the mechanical dismantling of Pier E3 and the controlled implosion. This text was produced by Sea Engineering in Procedures for Observations and Sampling San Francisco-Oakland Bay Bridge East Span Seismic Safety Project (Sea Engineering 2015).

Table 13. SFOBB Project Water Quality Objectives
Turbidity
Turbidity of the waters of the state, as measured in NTUs, will not increase above background levels by more than the following, to the extent practicable. Receiving Waters Background Incremental Increase Greater than or equal to 50 units, 10 percent of background, maximum
Floatables
Floating, suspended, or deposited macroscopic particulate matter or foam in waters of the state at any place more than 100 feet from the project boundary or point of discharge of return flow.
Petroleum Hydrocarbons
Visible floating, suspended, or deposited oil or other products of petroleum origin in waters of the state at any place.
Dissolved Oxygen
5.0 mg/l minimum. When natural factors cause lesser concentrations, then this discharge will not cause further reductions in the concentration of dissolved oxygen.
Dissolved Sulfide
0.1 mg/l maximum
pH
A variation of natural ambient pH by more than 0.5 pH units.

Table 13. SFOBB Project Water Quality Objectives
Toxic Or Deleterious Substances
None will be present in concentrations or quantities that may cause deleterious effects on aquatic biota, wildlife, or waterfowl, or that render any of these unfit for human consumption, either at levels created in the receiving waters or as a result of biological concentrations.
Note: Table text from Order No. R2-2002-0011 Source: San Francisco Bay RWQCB 2002

10.1.1. Turbidity Monitoring in Receiving Waters during Mechanical Dismantling

Before the start of mechanical dismantling activities, background water samples will be collected at least 900 feet (274 meters) from Pier E3. Background station B036, located southwest of Pier E3, will be used as the site for collection of the 24-hour background sample. Samples will be analyzed for turbidity measured in nephelometric turbidity units (NTU), pH, dissolved oxygen (milligrams per liter [mg/L]), and temperature (degrees Celsius [°C]). Standard observations also will be recorded and will include:

- Floating and suspended materials of waste origin (including oil, grease, algae, or other macroscopic particulate matter); presence or absence, source, and size of affected area;
- Discoloration and turbidity: description of color, source, and size of affected area;
- Odor: presence or absence, characterization, source, distance of travel, and wind direction;
- Hydrographic condition: time and height of corrected low and high tides; and depth of water columns and sampling depths;
- Weather condition: air temperature, wind direction and velocity, and precipitation.

Turbidity measurements will be taken at the north and south background stations closest to the pier every 2 hours while work is being completed. This will establish a current turbidity background. The highest background level will be used to establish the maximum background for project waters. Turbidity measurements will be completed along the project boundary to determine effects of construction on the receiving waters. The project boundary is defined as the daily limits of mechanical dismantling activities and includes the perimeter of safe vessel operation near construction equipment and other navigational obstructions. Actual monitoring locations will be determined in the field to account for tidal conditions, equipment configuration, and construction methods. Samples

will be taken every 2 hours while work is being completed. Any change in standard observations will be noted.

Turbidity, pH, and dissolved oxygen measurements will be collected using an YSI 6920 Environmental Monitoring System, or similar. The sampling techniques used by the individual probes on the YSI system will conform to specifications for water quality sampling and measurement (40 Code of Federal Regulations Section 136). The YSI systems will be deployed for measurements in a manner consistent with the manufacturer's specifications, for accuracy and quality of data collected. Calibrations for the individual probes on the YSI system will follow the manufacturer's specifications (i.e., full calibration of all probes at least every 30 days and weekly checks to ensure data quality).

Because of fluctuations resulting from tides, winds, waves, and other natural factors, additional depth-averaged turbidity and pH measurements will be taken at the appropriate background stations to establish a current water quality background. Background stations will be added as needed, if required by ongoing construction. If measured turbidity levels exceed the following criteria, then exceedance procedures must be followed:

- If background turbidity is less than 50 NTU, then the measured turbidity levels may not exceed 50 NTU;

- If the background turbidity is greater than 50 NTU, the measured turbidity levels may not exceed background turbidity by more than 10 percent.

If any results for turbidity show an exceedance in the receiving water limits, the following procedures will be followed:

- Confirm exceedance;

    - The sample location will be sampled again within 15 minutes to determine whether the exceedance is a continuous event.

    - If an exceedance still exists, the background stations on both the north and south side of the pier will be sampled to determine whether the background still indicates an exceedance near the project area.

    - If an exceedance still exists, sampling will be carried out closer to the environmentally sensitive area (ESA) along a direct line to determine whether the waters in the vicinity of the ESA are in exceedance of adjacent background

stations. The background stations closest to this sample also will be sampled to verify that the area of exceedance is moving towards the ESA. If it is not in exceedance, normal 2-hour sampling will continue.

- Acquire confirmation samples at exceedance location within 1 hour;
    - If sample is still in exceedance, the appropriate the Department personnel will be notified immediately.
- Hourly confirmation sampling will continue until turbidity levels are not in exceedance;
- Continuous communication will be maintained with the Department and the contractor;
- A report will be filed with the Department on the day of exceedance and will include a map showing the location of the areas of exceedance, the duration of the exceedance, and the nature of effects (i.e., all pertinent observations and analysis.

10.1.2. Receiving Water Monitoring Plans and Reporting

Written reports, calibration, maintenance records, and other records will be maintained by the Department and will be accessible at all times. Records will be kept for a minimum of 3 years. Records will include notes and observations for each sample, as follows:

- Identity of each sample, sampling station, and observations station by number;
- Date and time of sampling;
- Date and time analyses are started and completed and the name of personnel conducting analyses;
- Complete procedure used, including methods of preserving and analyzing sample and identity and volume or reagents used (a reference to a specific section of Standard Methods will be satisfactory);
- Calculation of results;
- Results of analyses and/or observations, including a comparison of the laboratory and field results for duplicate samples, and detection limits for each analysis; and

- Records including a map or maps of the site showing the sampling locations, work areas, photographs, and all other appropriate information.

Daily records, including all data, diagrams of sampling locations, and photographs, will be transmitted to the Department personnel through electronic mail at the end of each day.

10.1.3. Monitoring Plan for Dewatering during Mechanical Dismantling

In general, dewatering operations will be conducted in two phases. The initial phase of dewatering is to bring the water level down to a working level. The second phase is to maintain the water level; this is referred to as maintenance dewatering. All dewatering, storage, treatment, and discharge systems will be operated to achieve water quality objectives specified in the SFOBB Project's WDR (Table 13). Receiving water monitoring, as previously described in Section 10.1.2, will be performed during dewatering to monitor compliance with the water quality objectives.

Pier E3 caisson water will be passively treated on-site or disposed off-site at a publically owned treatment works (POTW). Potential passive treatment methods and best management practices can include settling tanks, reserve tanks for additional storage capacity, mechanical filtration (e.g., sand filter, bag filter), pH adjustment (e.g., dry ice), and hydrocarbon removal (e.g., oil socks, granular activated carbon). If these methods result in caisson water meeting all water quality objectives, it will be discharged to the San Francisco Bay. The quality of effluent discharged to the Bay resulting from dewatering operations will be monitored and screened against trigger levels. If excursions above trigger levels occur, appropriate procedures will be followed to correct the excursions. If appropriate procedures cannot ameliorate the excursions in a timely manner, discharges to the Bay will be halted and will be diverted to storage tanks for additional passive treatment or the application of best management practices. If implementation of passive treatment methods and best management practices do not result in caisson water attaining water quality objectives, caisson water will be off-hauled to a POTW.

10.2. Dewatering Monitoring Plan and Reporting

The monitoring contractor will provide the Department with a daily summary report for all in-situ sampling (i.e., turbidity, pH, temperature, observations of visual sheen, caisson water levels, conductivity-temperature-depth[CTD]-turbidity [T]-pH-dissolved oxygen[DO] casts, flow rates, and volumes discharged). Information provided will be similar to the monitoring requirements discussed in Section 10.1.2 for receiving water

monitoring. Weekly reports will compile all daily reports with weekly lab reports and will be provided to the Department by close of business on the Monday following receipt of laboratory data. Monthly reports will include data compiled from all weeks of the month and will be provided to the Department in tabular summary format by the 7th day of the following month.

10.3. Implosion Monitoring Plan

Models and studies suggest that impacts on water quality associated with the controlled implosion of Pier E3 will be temporary and minimal. To document impacts resulting from the controlled implosion, the following Pier E3 Implosion Sampling and Analysis Plan (SAP) was developed based on the SMP in the SFOBB Project's WDR, Order No. R2-2002-0011 (Brown and Caldwell, Amec Foster Wheeler 2015). This SAP either meets or exceeds the specifications in the SMP.

Water quality monitoring for the controlled implosion will use the following five approaches to monitoring:

- **Dynamic Plume Mapping**: Dynamic and static water column profiling techniques will define the three-dimensional extent of the plume and track its dispersion over a 6 to 8-hour window following the implosion. Dynamic plume profiling will consist of towing a continuously monitoring array to define the three-dimensional shape of the plume, while static profiling will include raising and lowering a monitoring device from a stationary vessel.

- **Current-Tracking Drogues:** Current drogues will be used to help track the movement of the plume and guide the profiling effort. The drogues are floating monitoring devices, capturing data in real-time. They will be suspended from a surface float at a target depth determined by the length of a suspension line and will hang vertically in the water column perpendicular to the direction of the current flow. Attached buoys with GPS sensors and radio transmitters will send drogue position coordinates to the plume mapping vessel. Drogues will be deployed in pairs after the implosion to move with the current and track the plume in real-time. A separate vessel will be tracking the drogues as they move along the current and prevent the drogues from encountering any obstructions.

- **Environmentally Sensitive Area (ESA) monitoring**: To confirm that the water quality in the vicinity of the eelgrass beds was not impacted, continuous monitoring

buoys will be measuring turbidity and pH at the mid-depth of the water column near the ESA. Additional information regarding the buoys is presented below.

- **Water Quality Grab Sampling:** Water quality sampling will be conducted from a separate vessel from the plume mapping vessel and will measure constituents of concern and acute toxicity. Grab samples will be collected from the vessel as it moves along the path of the plume, as observed by water quality monitors located in elevated positions. Constituents of concern from the controlled implosion will include pH, suspended solids concentration, and total and dissolved metals.

- **Sediment Quality Assessment:** Sediment analysis will be conducted before and after the implosion, to measure potential benthic effects and attenuation rates. A random stratified sampling design will be implemented to test the spatial variability of sediment chemistry (metals and pH) and toxicity at the sediment-water interface.

10.4. Water Quality Monitoring Buoys

Water quality logging instruments will be deployed on a network of buoys and water quality profiling and sampling will be performed from vessels. Buoy-mounted water quality sensors will remotely collect high-resolution temporal water quality data. The layout of the buoy network was informed by three-dimensional hydrodynamic and sediment transport modeling, bathymetry of the Demonstration Project area, anticipated tidal conditions, locations of environmentally sensitive eelgrass beds around YBI and Treasure Island, and the avoidance of shipping lanes; see Figure 12 for the preliminary layout (Sea Engineering 2014).

Water quality monitoring buoys will be deployed near environmentally sensitive eelgrass beds near the project area; equipping these buoys with telemetry to alert water quality monitors of potential impacts in real time is under consideration. A “control” buoy will be located at the B001 location, which has been used since monitoring began for the SFOBB Project in July 2002, providing long-term background ambient condition data. All buoys will monitor turbidity, pH, dissolved oxygen, temperature, and conductivity. Additional monitoring buoys will be available for immediate deployment if the plume’s track deviates from the model (Sea Engineering 2014).

Water quality sensors will be suspended from each monitoring buoy at three depths, if possible: within 3.3 feet (1 meter) of the water surface, approximate mid-point of the water column, and within 3.3 feet (1 meter) of the Bay floor, unless water depths are too shallow to accommodate three water quality sensors. Eelgrass bed monitoring will be

Source: Sea Engineering

Figure12. Diagram of the Receiving Water Monitoring Plan

conducted with one logging instrument because these habitats are located in shallow areas where stratification of waters is unlikely. Each logging device will measure CTD, turbidity, pH, and dissolved oxygen. Water quality logging instrumentation will be a YSI 6920 V2-2 Environmental Monitoring System or equivalent. Background water quality data will be collected from the buoy-mounted water quality logging devices before the controlled implosion. The buoys will continue logging water quality data for 48 hours after the controlled implosion to monitor any other potential effects.

10.5. Background Monitoring

Background water quality profiles and grab samples also will be collected. Baseline water quality profiles will include CTD, turbidity, pH, and dissolved oxygen. Additional baseline data will be obtained using an array of Niskin bottles to collect whole water samples at discrete depths. All background and controlled implosion whole water samples will be analyzed for total suspended solids, dissolved sulfide, dissolved copper, dissolved nickel, dissolved zinc, dissolved chromium, dissolved silver, dissolved cadmium, and dissolved lead.

10.6. Day of Implosion Monitoring

When safety restrictions are lifted after the controlled implosion, the sediment plume will be monitored by a marine vessel and guided by the current-tracking drogues. In accordance with this monitoring plan and guided by the drogues, the water quality of the plume will be observed. Specifically, monitors will measure depth-averaged CTD, turbidity, pH, and dissolved oxygen; Niskin bottles will be used to collect total suspended solids, dissolved sulfide, and dissolved metal samples at three discrete depths; and an Acoustic Doppler Current Profiler (ADCP) will be used to continuously measure depth-resolved acoustic backscatter, as described next. Standard observations also will be performed, as defined in the WDR's SMP (Sea Engineering 2014).

High-resolution turbidity and suspended sediment data will be obtained using an ADCP. The ADCP will measure depth-resolved acoustic backscatter continuously throughout the water column at sub-meter horizontal and vertical scales. Acoustic backscatter, a proxy for total suspended solids and turbidity, will be correlated with suspended solids concentrations resulting from the analysis of grab samples. The relationship between acoustic backscatter and detected suspended sediment concentrations will be used to transform acoustic backscatter data into turbidity values and suspended sediment concentrations (Sea Engineering 2014).

Vessel-based monitoring will cease after monitoring data are consistent with baseline data. A bathymetric survey will be performed after the controlled implosion to document elevation changes in the Bay floor related to sedimentation. The survey will be compared to pre-Demonstration Project bathymetric surveys, to estimate the total amount of sediment that was suspended and subsequently deposited (Sea Engineering 2014).

Quality assurance/quality control (QA/QC) samples, such as duplicates and field and equipment blanks, will be collected so as to make up 10 percent or more of the total samples collected. The laboratory will perform standard QA/QC procedures to determine the accuracy of the water sample data. In addition, the buoy monitoring data will be calibrated to NIST standards before deployment. Following recovery, data will be compiled and transformed into depth-averaged water quality for monitoring stations where multiple logging devices are deployed.

10.7. Water Quality Reporting for Implosion

After the controlled implosion of Pier E3, the Department will file a comprehensive report with all stakeholder agencies, containing the following, at a minimum:

- Compliance evaluation summary, including descriptions of exceedances of receiving water limitations or water quality objectives, the duration of the exceedances, and corresponding observations and data;
- Monitoring methods, equipment, and data, including DVDs with all water quality logging data;
- Contingency reporting, as described in the SMP;
- Estimate of the total amount of sediment that was suspended and subsequently deposited;
- Summary of standard observations, as defined in the WDR issued to the SFOBB Project;
- Discussion regarding the effectiveness of the monitoring methods;
- Assessment of the impacts on special aquatic sites; and
- Data to be used for calibration and refinement of the three-dimensional hydrodynamic and sediment transport model for subsequent demolition activities.

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